



Instruction Manual

Specification & Maintenance Data

PUMA VT900/M/-2SP/M-2SP

INTRODUCTION

Thank you for choosing an DOOSAN Infracore Model. We are proud to have you among our DOOSAN Infracore family of users.

This instruction manual contains concise information on the installation, setup, operation and maintenance of your Model PUMA VT900/M/-2SP/M-2SP CNC lathe. To make the most of its outstanding performance over a long period, the machine must be properly installed and operating and maintenance procedures must be clearly understood and carefully followed. You are encouraged to study this instruction manual carefully before the machine is installed and to keep it on file for future reference.

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CONSTRUCTION

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SECTION A

INSTALLATION & MAINTENANCE

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1. Specification

1.1 Machine standard specifications

DESCRIPTIONS			UNIT	SPECIFICATIONS				REMARK
				PUMA VT900	PUMA VT900 M	PUMA VT900- 2SP	PUMA VT900 M-2SP	
CAPACITY	Swing over bed		mm(inch)	1,000(39.37)				
	Max. turning diameter		mm(inch)	900(35.43)				
	Max. turning length		mm(inch)	850(33.46)				
	Spindle center height		mm(inch)	1,260(49.60)				
SPINDLE	Nose type			ASA A2-15				()OPTION
	Taper of hole			Taper 1/20				
	Front bearing diameter		mm(inch)	200(7.87)				
	Hole diameter		mm(inch)	110(4.33)				
SPINDLE DRIVE	Number of spindle speed			2 Step				
	Spindle speed		r/min	5 ~ 1,800				
	Spindle command speed method			None				
	Spindle override speed		%	50 ~ 150				
FEED AXIS	Travel	X-axis	mm(inch)	470(18.50)				
		Z-axis	mm(inch)	850(33.46)				
	Rapid traverse rate	X-axis	m/min(ipm)	20(787)				
		Z-axis	m/min(ipm)	20(787)				
	Feed range		mm(inch)/rev	F=0.001~ 500(19.69)				
	Cutting feed override		%	0 ~ 200				(10% Step)
TURRET	Type			V12	BMT85 P	V12	BMT8 5P	
	Max. number of tools		ea	12		12+12		
	Standard shank size		mm(inch)	Ø80(3)				
	Tool size	Standard	mm(inch)	Ø 32 (Ø 1 1/4")	Ø 32 (Ø 1 1/4")	Ø 32 (Ø 1 1/4")	Ø 32 (Ø 1 1/4")	
		DRILL	mm			Ø30		
		ENDMILL	mm			Ø30		
		TAP	mm			M20		

A-2 INSTALLATION & MAINTENANCE

DESCRIPTIONS			UNIT	SPECIFICATIONS				REMARK
				PUMA VT900	PUMA VT900M	PUMA VT900- 2SP	PUMA VT900M- 2SP	
ELECTRIC EQUIPMENT	NC unit type			F- 21iT (0It)		F- 18iT		()OPTION
	Main spindle motor Continuous 30 min. rating		kW	AC 37/45				
	Hydraulic pump motor		kW	2.8 X 1EA		2.8 X 2EA		
	Way lubricating pump motor		W	46				
	Coolant pump motor		kW					()OPTION
				1.5(2.2, 3.7) X 1EA		1.5(2.2, 3.7) X 2EA		
	Fluorescent lamp for lighting			AC220V				
	Total power consumption		kVA	75	80	145	155	
	Controlled axis			X, Z	X, Z,C	X, Z	X, Z,C	
Machine size	Floor space required	Width	mm(inch)	3050(119)				
		Length	mm(inch)	2130(83.9)		4270(168.1)		
	Overall machine height		mm(inch)	3,621(412.56)				
	APP. Machine weight		kg	12,5000		25,000		

1.2 Standard accessories

No.	Name	Specifications	Q'ty	
			PUMA VT900/M	PUMA VT900/M -2SP
1	Numerical control system	FANUC SYSTEM 21iT	1 set	-
		FANUC SYSTEM 18iT	-	1 set
2	Hydraulic power unit	EHU25-M07-AE-30-V-162(DIKIN)	1 set	2 set
		Tank caper 10ℓ(2.6gal)		
3	Hyd. chuck	24"solid chuck	1 set	2 set
4	Coolant equipment	1.5kW	1 set	2 set
5	Machine light	AC 220V-36W	1 set	2 set
6	Door and chip pan	With manually sliding door	1 set	2 set
7	Mounting plates(DOOSAN)		8pcs	2 X 8pcs
8	Service tools and tools box		1 set	1 set
10	Hyd. chuck direction switch	Manually operated key switch.	1 set	2 set
11	Program protect function	Manually operated key switch	1 set	1 set
12	Safety lock release	Manually operated key switch.	1 set	2 set
13	Chuck close/open switch	Foot switch.	1 set	2 set
14	Oil feeding tank (LUB.)	Cape:2ℓ (0.25 gal)	1 set	1 set
15	Electrical spare parts	fuses	1 set	1 set
16	Operation manual		1 set	1 set
17	Electric circuit diagram		1 set	1 set
18	Coolant flushing for bed	900W	1 set	2 set
19	Coolant flushing for chuck	400W	1 set	2 set
20	Prevent turret drop		1 set	2 set
21	Soft jaws		1 set	2 set

1.3 List of service tools

NO	NAME	SPECIFICATION	Q'TY
1	BOX. TOOL	N02. PLASTIC	1
2	SPANNER. SINGLE ENDED	MS30	1
3	SPANNER. DOUBLE ENDED	MB7X8	1
4	SPANNER. DOUBLE ENDED	MB8X10	1
5	SPANNER. DOUBLE ENDED	MB10X12	1
6	SPANNER. DOUBLE ENDED	MB12X14	1
7	SPANNER. DOUBLE ENDED	MB13X17	1
8	SPANNER. DOUBLE ENDED	MB17X19	1
9	SPANNER. DOUBLE ENDED	MB19X22	1
10	SPANNER. DOUBLE ENDED	MB21X23	1
11	SPANNER. DOUBLE ENDED	MB22X24	1
12	SPANNER. DOUBLE ENDED	MB24X27	1
13	SET. BALL HEX L-WRENCH	MP1.5-10/13609	1
14	L-WRENCH	MP12/SCM3	1
15	L-WRENCH	MP14/SCM3	1
16	DRIVER. SCREW(-)	6 x 100L/#2(-)	1
17	DRIVER. SCREW(+)	6 x 100L/32(+)	1

1.4 Machine Accessories and Equipment

1. Tooling

<PUMA VT900/VT900-2SP>

1) Tool holder

ITEM	METRIC		INCH	
OD TOOL HOLDER	$\pi 32$ mm	std	$\pi 1.25$ inch	std
FACE TOOL HOLDER	$\pi 32$ mm	std	$\pi 1.25$ inch	std
ID TOOL HOLDER	80 mm	std	3 inch	std
U-DRILL CAP	-	std	-	std

2) Tool Sleeves

ITEM	METRIC		INCH	
BORING SLEEVES	ID10	opt	ID3/8	opt
	ID12	opt	ID1/2	opt
	ID16	opt	ID5/8	opt
	ID20	std	ID3/4	std
	ID25	std	ID1	std
	ID32	std	ID1-1/4	std
	ID40	std	ID1-1/2	std
	ID50	std	ID2	std
	ID60	std	ID2-1/2	std
DRILL SOCKETS	MT#2	opt	MT#2	opt
	MT#3	std	MT#3	std
	MT#4	std	MT#4	std
	MT#5	std	MT#5	std
U-DRILL SLEEVES	ID20	opt	ID3/4	opt
	ID25	opt	ID1	opt
	ID32	std	ID1-1/4	std
	ID40	std	ID1-1/2	std
	ID50	std	ID2	std
	ID60	std	ID2-1/2	std

<PUMA VT900M/VT900M-2SP>

1) Tool holder

ITEM		METRIC		INCH	
STATIC TOOL HOLDER	OD TOOL HOLDER	$\pi 32$ mm	std	$\pi 1.25$ inch	std
	FACE TOOL HOLDER	$\pi 32$ mm	std	$\pi 1.25$ inch	std
	ID TOOL HOLDER	80 mm	std	3 inch	std
MILLING TOOL HOLDER	STRAIGHT(SHORT)	BMT85	std	BMT85	std
	ANGLULAR	BMT85	std	BMT85	std
	STRAIGHT(SHORT/TTC)	BMT85	opt	BMT85	opt
	ANGLULAR(TTC)	BMT85	opt	BMT85	opt

2) Tool Sleeves

ITEM	METRIC		INCH	
BORING SLEEVES	ID10	opt	ID3/8	opt
	ID12	opt	ID1/2	opt
	ID16	opt	ID5/8	opt
	ID20	std	ID3/4	std
	ID25	std	ID1	std
	ID32	std	ID1-1/4	std
	ID40	std	ID1-1/2	std
	ID50	std	ID2	std
	ID60	std	ID2-1/2	std
DRILL SOCKETS	MT#2	opt	MT#2	opt
	MT#3	std	MT#3	std
	MT#4	std	MT#4	std
	MT#5	std	MT#5	std
U-DRILL SLEEVES	ID20	opt	ID3/4	opt
	ID25	opt	ID1	opt
	ID32	std	ID1-1/4	std
	ID40	std	ID1-1/2	std
	ID50	std	ID2	std
	ID60	std	ID2-1/2	std

ITEM		METRIC		INCH	
MILLING COLLETS(ER50)		ER50-MM-BOX	std	ER50-INCH-BOX	std
		ER50-6MM	std	ER50-6/16	std
		ER50-8MM	std	ER50-7/16	std
		ER50-10MM	std	ER50-8/16	std
		ER50-12MM	std	ER50-9/16	std
		ER50-14MM	std	ER50-10/16	std
		ER50-16MM	std	ER50-12/16	std
		ER50-18MM	std	ER50-14/16	std
		ER50-20MM	std	ER50-1	std
		ER50-22MM	std	ER50-20/16	std
		ER50-25MM	std	ER50-22/16	std
		ER50-27MM	std		std
		ER50-32MM	std		std
MILLING ADAPTERS	BOX. ADAPTER KIT	BMT85P	std	BMT85P	std
	SPANNER. COLLET ADAPTER	UM/ER40	std	UM/ER40	std
MILLING ADAPTERS	SPANNER. MILL ARBOR ADAPTER	D27	std	D22	std
	WRENCH. TEE	H6XL 150	std	H6XL 150	std
	SCREW. TAPER	M8(SW6)	std	M8-SW6	std
	SCREW. SET	M12XP1XL16	std	M12XP1XL16	std
	ADAPTER. COLLET	BMT85P-ER40	std	BMT85P-ER40	std
	ADAPTER. WELDON	BMT85P-ID16MM	opt	BMT85P-ID10/16	opt
		BMT85P-ID20MM	opt	BMT85P-ID12/16	opt
		BMT85P-ID25MM	opt	BMT85P-ID16/16	opt
		BMT85P-ID32MM	std	BMT85P-ID20/16	std
	ADAPTER. WHISTLE NOTCH	BMT85P-ID16MM	opt	BMT85P-ID10/16	opt
		BMT85P-ID20MM	opt	BMT85P-ID12/16	opt
		BMT85P-ID25MM	opt	BMT85P-ID16/16	opt
		BMT85P-ID32MM	opt	BMT85P-ID20/16	opt
	ADAPTER. SHELL MILL ARBOR	BMT85P-ID16MM	opt	BMT85P-ID12/16	-
		BMT85P-ID22MM	opt	BMT85P-ID16/16	std
		BMT85P-ID27MM	std		

3) Chuck & Cylinder(PUMA VT900/PUMA VT900M)

TYPE	MAKER	REMARKS
24" SOLID + Y2050RE	SAMCHULLY	○
32" SOLID + Y2050RE	SAMCHULLY	△
Y2050RE CYLINDER ONLY	SAMCHULLY	△

2. OPTIONAL SPECIFICATIONS & EQUIPMENT

NAME	SPECIFICATION
1) HYDRAULIC POWER CHUCK	- 32" 3-JAW CLOSED CENTER CHUCK
2) SPINDLE	- α30+ZF Gear box spindle
3) CHIP CONVEYOR	- Rear mount, hinged belt (steel cutting)
	- Rear mount, scraper (cast iron)
	- Side mount, hinged belt (steel cutting)
	- Side mount, scraper (cast iron)
4) COOLANT PUMP	- 0.9 kW x 0.45 MPa x 30 L/min, or
	- 2.2 kW x 1.0 MPa x 30 L/min, or
	- 3.7 kW x 1.45 MPa x 30 L/min, or
5) OTHERS	- Air blast for chuck jaw cleaning
	- Automatic door
	- Automatic door with safety edge (Bumper switch)
	- Chip bucket
	- Straddle tool ready (Piping & Solenoid valve, Exclude straddle tool)
	- Dual chucking pressure
	- Hardened & ground jaws
	- Manual tool presetter (Quick tool setter)
	- Oil skimmer (Belt type)
	- Signal tower (yellow, red, green)
	- Proximity switch for chuck clamp detection
	- Coolant gun
	- Coolant pressure switch
	- Line filter for coolant
	- *Special chucks

Specification marked by "*" should be reviewed in detail before contract.

1.5 NC Unit Specifications

1. FANUC – 21iT <PUMA VT900/M>

○:Standard △: Option

Item	Specifications		F-21iTB
Number of controlled axes	X,Z simultaneous 2 axes(simultaneous 3,4 axis)		○
Interpolation	Positioning/linear/taper/circular/thread		○
Dimensioning system	Absolute/ incremental programming		○
Minimum input increment	X,Z 0.001 mm (0.0001 inch)		○
Max. programmable dimension	±8 digits (Decimal point input possible)		○
program input	MDI mode Input		○
	ISO/EIA input		○
	I/O interface (RS232C)		○
	Program protect		○
	Back ground edit		○
Display	9.5" Mono LCD		○
	Graphic display function		△
	English		○
Spindle function	S4 digit, direct rpm command		○
	Spindle speed override(10% step)		50~150
	Constant surface speed control		○
	Spindle orientation (electric type)		△
Tool function	Tool selection T2 + 2		○
	Tool offset ±6 digits	64 pairs	○
		99 pairs	△
	Incremental tool offset		○
	Tool offset value counter input		○
	Input of offset value measured A		○
	Input of offset value measured B (for QTS)		△
	Tool geometry offset and tool wear offset		○
	Tool life management		○
Zero return	Manual & automatic zero return		○
	Second reference point return		○
Feed function	Rapid traverse X-axis 20 m/min. Z-axis 20 m/min (49 feet/min)		○
	Cutting feed 0.0001 – 500 mm/rev.		○
	Feed override 0-200% (10% step)		○
	Rapid traverse override 1% (F0 ~ 100%)		○
	Manual pulse generator 0.001,0.01, 0.1 mm(0.0001,0.001,0.01in.)		○

Item	Specifications		F-21ITB
Auto operation	Dry run		○
	Machine lock		○
	Single block		○
	Optional stop		○
	Feed hold		○
Manual Operation	Jog feed		○
	Spindle : CW/CCW, Inching ,OFF		○
	Turret Index		○
	Coolant : ON/OFF/AUTO, Manual ON/OFF		○
Programming	Radius programming on arc		○
	Tool nose radius compensation		○
	Chamfering / Corner-R		○
	Dwell		○
Programming	Canned cycle		○
	Multiple repetitive cycle I(G70-G76)		○
	Work coordinate system shift		○
	Optional block skip		○
	Addition of optional block skip (max.9)		△
	Program list		○
	Inch/metric conversion		△
	Custom macro B		○
	Multiple repetitive cycle II (G71)		△
	Registered programs	160m	○
		320m	△
		640m	△
		1280m	△
	Sequence number search	63 EA	○
		125EA	△
		200EA	△
Other function	Sequence number search		○
	Program number search		○
	Backlash compensation		○
	Buffer register		○
	Soft limit 1		○
	Automatic acceleration/ deceleration		○
	Automatic coordinate system setting		△
	External data Input/ Output function		△

2. FANUC – 0iT <PUMA VT900/M:OPTION>

○:Standard △: Option

Item	Specifications		F-0ITB
Number of controlled axes	X,Z simultaneous 2 axes(simultaneous 3,4 axis)		○
Interpolation	Positioning/linear/taper/circular/thread		○
Dimensioning system	Absolute/ incremental programming		○
Minimum input increment	X,Z 0.001 mm (0.0001 inch)		○
Max. programmable dimension	±8 digits (Decimal point input possible)		○
Program input	MDI mode Input		○
	ISO/EIA input		○
	I/O interface (RS232C)		○
	Program protect		○
	Back ground edit		△
Display	9.5" Mono LCD		○
	Graphic display function		△
	English		○
Spindle function	S4 digit, direct rpm command		○
	Spindle speed override(10% step)		○
	Constant surface speed control		○
	Spindle orientation (electric type)		△
Tool function	Tool selection T2		○
	Tool offset ±6 digits	64 pairs	○
	Incremental tool offset		○
	Tool offset value counter input		○
	Input of offset value measured A		○
	Input of offset value measured B (for QTS)		○
	Tool geometry offset and tool wear offset		△
	Input program of tool offset		○
	Tool life management		○
Zero return	Manual & automatic zero return		○
	Second reference point return		○
Feed function	Rapid traverse X-axis 20 m/min. Z-axis 20 m/min		○
	Cutting feed 0.0001 – 500 mm/rev.		○
	Feed override 0-200% (10% step)		○
	Rapid traverse override 1%(F0 ~ 100%)		○
	Manual pulse generator 0.001, 0.01, 0.1 mm (0.0001, 0.001, 0.01 in.)		○

Item	Specifications		F-0ITB
Auto operation	Dry run		○
	Machine lock		○
	Single block		○
	Optional stop		○
	Feed hold		○
Manual Operation	Jog feed		○
	Spindle : CW/CCW, Inching ,OFF		○
	Turret Index		○
	Coolant : ON/OFF/AUTO, Manual ON/OFF		○
	Radius programming on arc		○
Programming	Tool nose radius compensation		○
	Chamfering / Corner-R		○
	Dwell		○
	Canned cycle		○
	Multiple repetitive cycle I (G70-G76)		○
	Work coordinate system shift		○
	Optional block skip		○
	Addition of optional block skip (max.9)		△
	Program list		○
	Inch/metric conversion		○
	Custom macro B		○
	Multiple repetitive cycle II (G71)		△
	Part program storage length		○
	Registered programs	640 m	○
	Sequence number search	400 EA	○
Other function	Program number search		○
	Backlash compensation		○
	Buffer register		○
	Soft limit 1		○
	Automatic acceleration/ deceleration		○
	Automatic coordinate system setting		○
	External data Input/ Output function		△

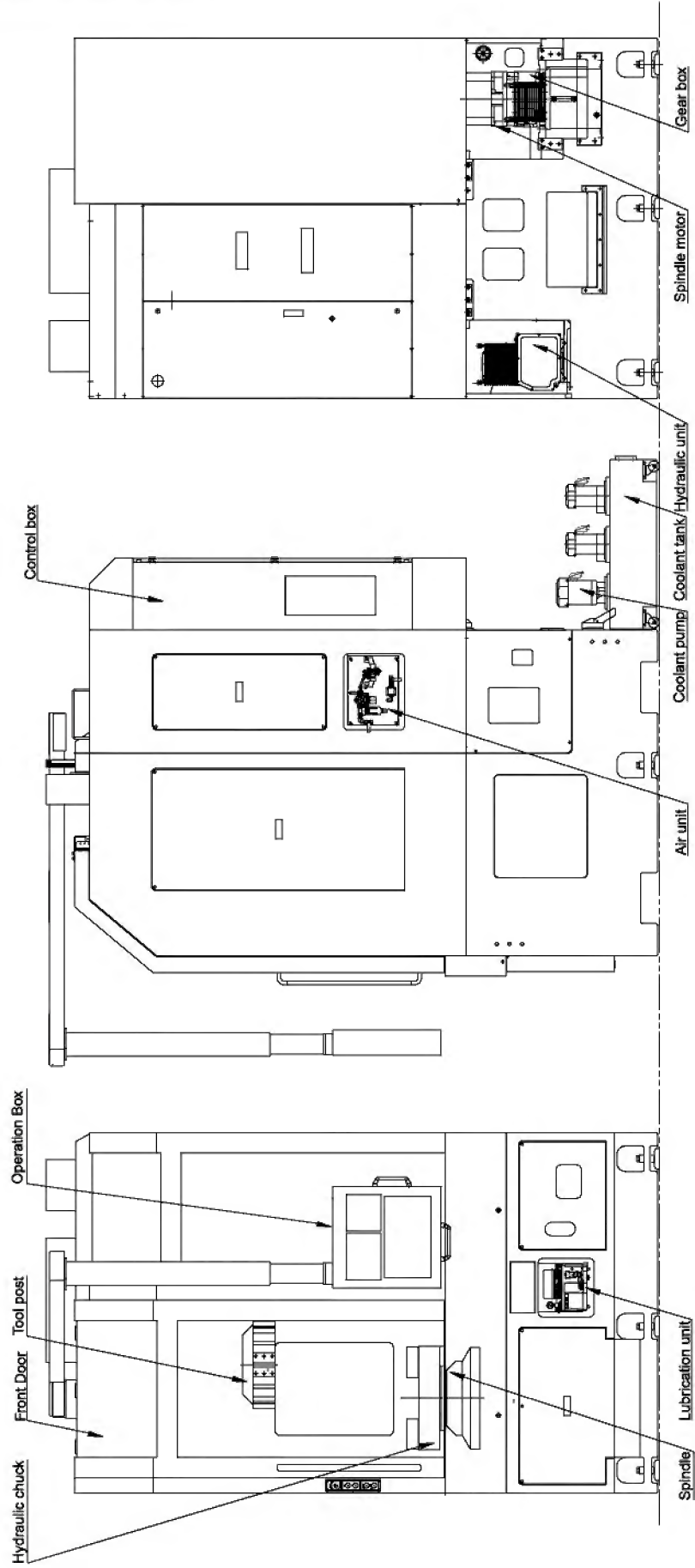
3. FANUC – 18iT <PUMA VT900-2SP/M-2SP>

○:Standard △: Option

Item	Specifications		F-18iT
Number of controlled axes	X,Z simultaneous 2 axes(simultaneous 3,4 axis)		○
Interpolation	Positioning/linear/taper/circular/thread		○
Dimensioning system	Absolute/ incremental programming		○
Minimum input increment	X,Z 0.001 mm (0.0001 inch)		○
Max. programmable dimension	±8 digits (Decimal point input possible)		○
program input	MDI mode Input		○
	ISO/EIA input		○
	I/O interface (RS232C)		○
	Program protect		○
	Back ground edit		○
Display	9.5" Mono LCD		○
	Graphic display function		△
	English		○
Spindle function	S4 digit, direct rpm command		○
	Spindle speed override(10% step)		0~200
	Constant surface speed control		○
	Spindle orientation (electric type)		△
Tool function	Tool selection T2 + 2		○
	Tool offset ±6 digits	64 pairs	○
		99 pairs	△
		400 pairs	△
		999 pairs	△
	Incremental tool offset		○
	Tool offset value counter input		○
	Input of offset value measured A		○
	Input of offset value measured B (for QTS)		△
	Tool geometry offset and tool wear offset		○
Zero return	Manual & automatic zero return		○
	Second reference point return		○
Feed function	Rapid traverse X-axis 20 m/min. Z-axis 20 m/min (49 feet/min)		○
	Cutting feed 0.0001 – 500 mm/rev.		○
	Feed override 0-200% (10% step)		○
	Rapid traverse override 1% (F0 ~ 100%)		○
	Manual pulse generator 0.001,0.01, 0.1 mm(0.0001,0.001,0.01in.)		○

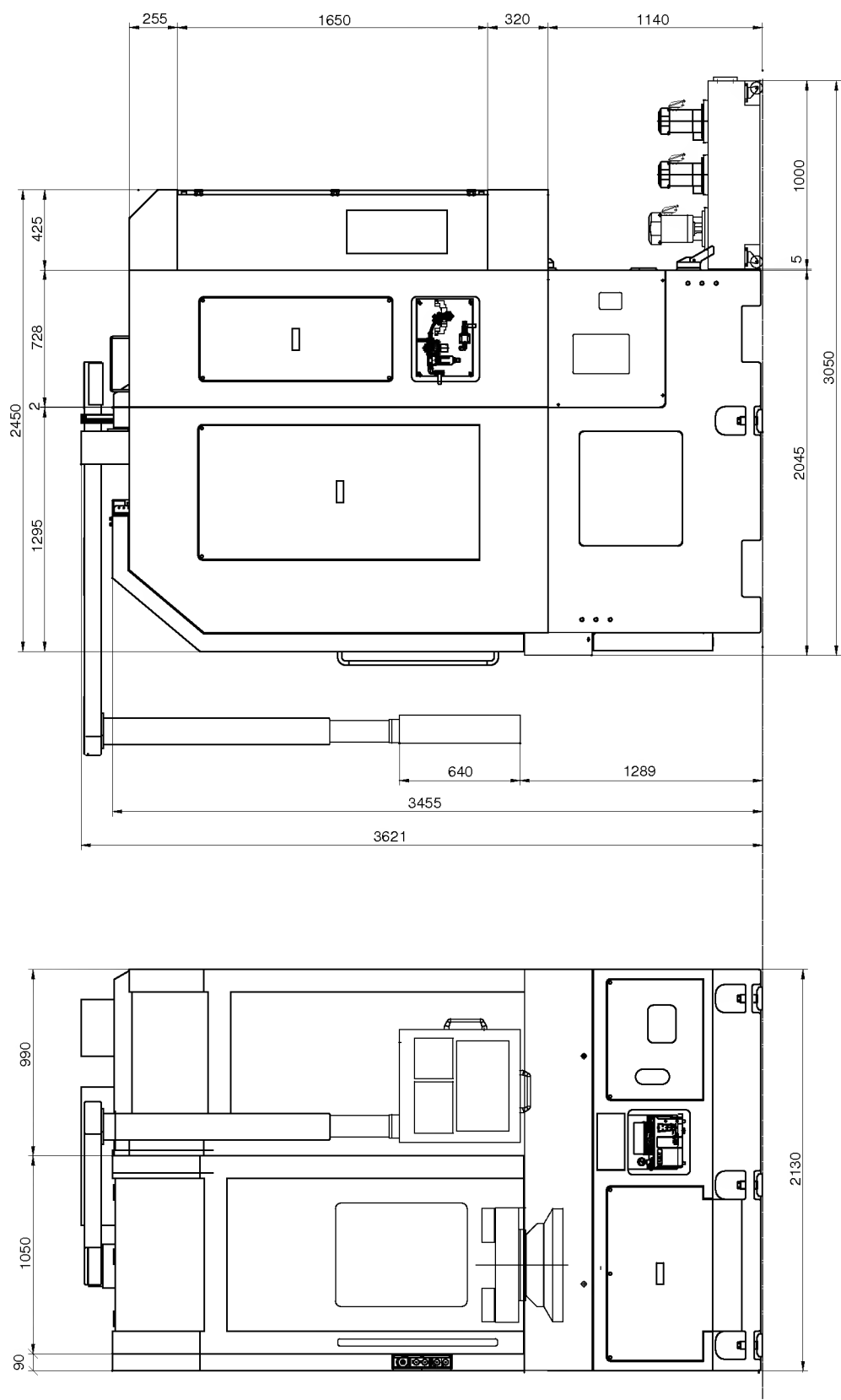
Item	Specifications		F-18iTB
Auto operation	Dry run		○
	Machine lock		○
	Single block		○
	Optional stop		○
	Feed hold		○
Manual Operation	Jog feed		○
	Spindle : CW/CCW, Inching ,OFF		○
	Turret Index		○
	Coolant : ON/OFF/AUTO, Manual ON/OFF		○
Programming	Radius programming on arc		○
	Tool nose radius compensation		○
	Chamfering / Corner-R		○
	Dwell		○
Programming	Canned cycle		○
	Multiple repetitive cycle I (G70-G76)		○
	Work coordinate system shift		○
	Optional block skip		○
	Addition of optional block skip (max.9)		△
	Program list		○
	Inch/metric conversion		○
	Custom macro B		○
	Multiple repetitive cycle II (G71)		○
	Registered programs	160m	○
		320m	△
		640m	△
		1280/2560m	△
	Sequence number search	125EA	○
		200EA	△
		400EA	△
		1000EA	△
Other function	Sequence number search		○
	Program number search		○
	Backlash compensation		○
	Buffer register		○
	Soft limit 1		○
	Automatic acceleration/ deceleration		○
	Automatic coordinate system setting		○
	External data Input/ Output function		△

1.6 Description of machine

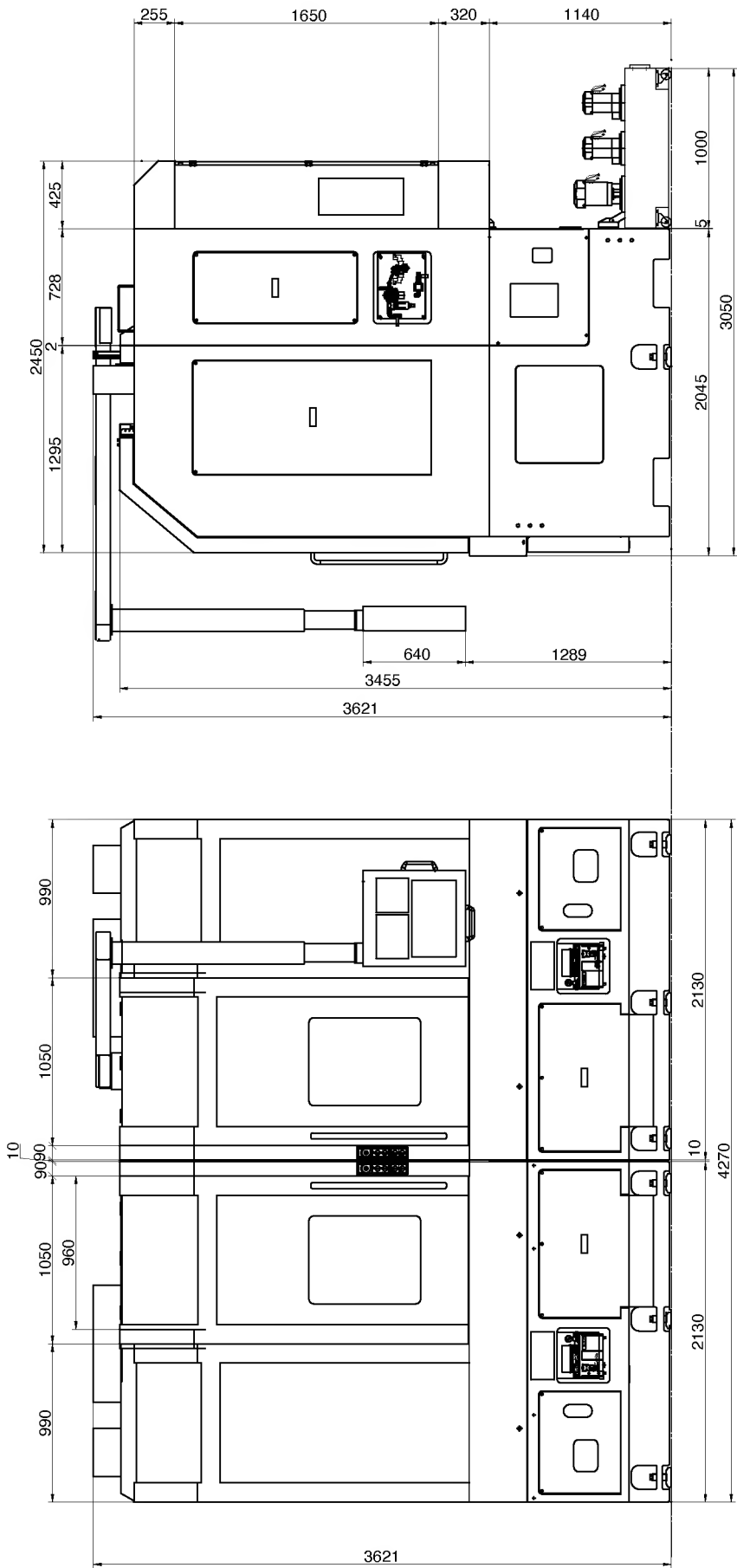


1.7 Dimension of machine

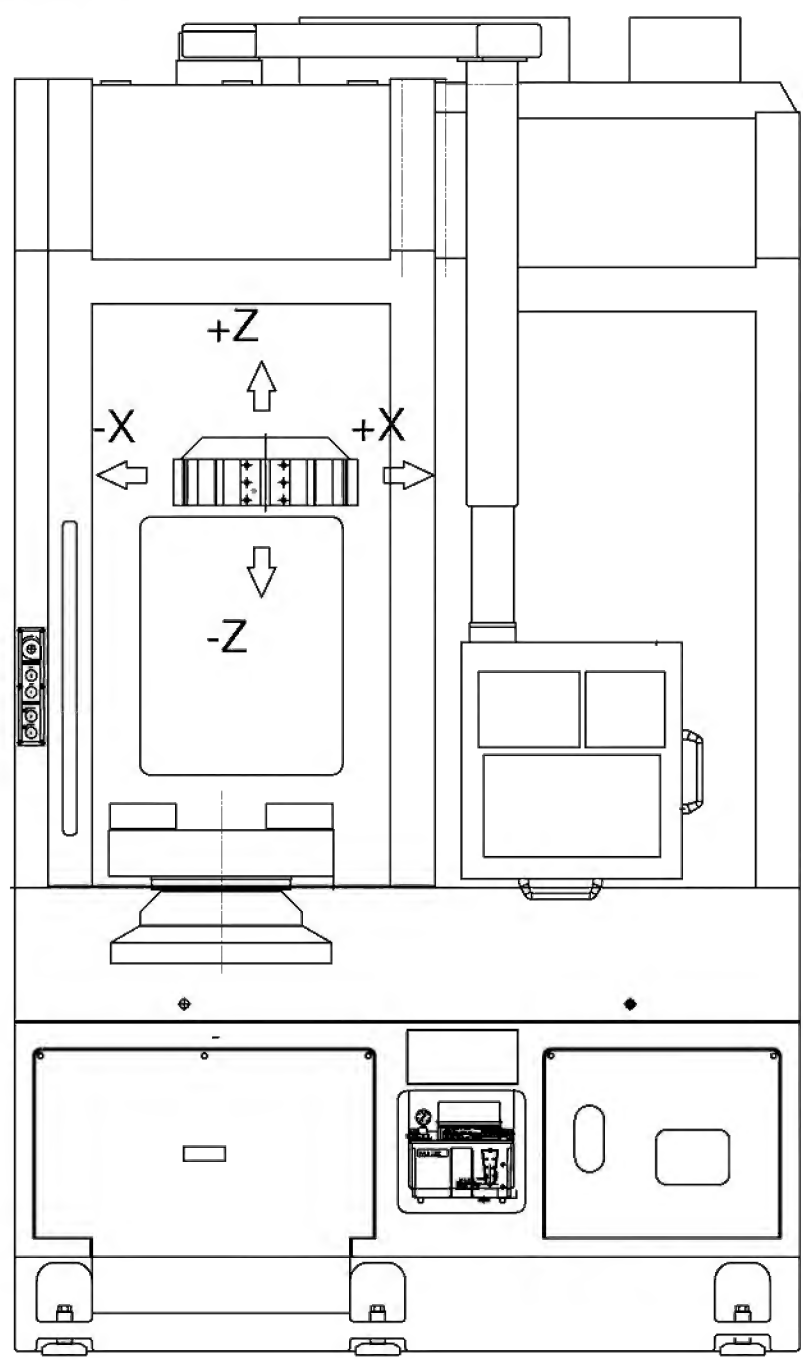
1. PUMA VT900



2. PUMA VT900-2SP



1.8 **Axis feed direction**



1.9 CE declaration



Doosan Infracore Co., Ltd.

Changwon Plant #1 : 601-3, NamsanDong, Changwon, Kyungsangnam-Do, Korea.

Tel : -825512804533 Fax : -825512829041

EC Declaration of Conformity

We hereby certify that the Turning Center or Machining Center specified hereunder confirms in all respects to the requirements of the Council Directive 2006/42/EC, 2006/95/EC, 2004/108/EC, EN12100-1/2005, EN12100-2/2005 and EN60204-1/2005.

Name and address of person in the European Community authorised to hold the technical file:

Doosan Infracore Germany GmbH, Hans-blocker-strasse, 29 D-40764
Langenfeld-Fuhrkamp

Name of the Machine	:	_____
Machine Model type	:	_____
Serial Number of the Machine	:	_____
Year of Manufacture	:	_____
Date of Issue	:	_____

Signature of Manufacturer : *Kyu Ho Pae*

Kyu-ho, Pae
Managing Director
Quality Management
Machine Tools & FA BG.



2. Installation

2.1 Environment Requirements

There is no special environment condition to respect, check the table "Environment Conditions" as shown below.

Normally every industrial place with a good light condition, good air change and a strong floor can be considered correct.

For floor characteristics, distance from walls and foundation please check carefully "Chapter 5. Foundation plan" of this manual.

Environment Conditions

Characteristics	Unit of Measure	Value
Minimum light level	lux	300
Thermal range	°C	min. 0 — max. 40
Maximum Humidity		75 % (a 20°C)
Maximum floor inclination		0,5 ‰
Minimum floor resistance	kg/m ²	1500

NOTE

In order to ensure high machine accuracy and performance, the following points should be considered with regard to the installation site.

Avoid the following places when choosing the installation site for the machine:

- Places subject to direct sunlight, near heat sources, or subject to excessive temperature change
- Humid places
- Dusty places
- Places near vibration generating equipment
- Weak soil

(1) Foundation work is advised for sites where the subsoil is soft, to prevent the machine from tilting or sinking after installation.

For details regarding foundations, refer to Fig. D-4.

(2) The installation site should be as far as possible from vibration sources such as roads, stamping/press equipment, or planer machine tools.

If nearby sources of vibration are unavoidable, prepare dampening pits around the foundation to reduce the vibration effects. (during operation: Less than 0.5G)

(3) NC malfunctions could result from the proximity of high-frequency power generators, electric discharge machines, and electric welding machines, or when power is supplied from the same distributor panel as these machines.

For wiring details, consult our service engineer dispatched to assist with installation.

- (4) The ideal operating environment calls for an ambient temperature of 20°C(68°F), with humidity between 40 and 75%.
- (5) Keeping the ambient temperature at a constant level is an essential factor for accurate machining.
- (6) In order to maintain static machine accuracy within guaranteed values, the machine installation site should be located so that it is unaffected by air currents within the factory.
Although air-conditioning is not required, the optimal ambient temperature range is 17°C to 25°C.(63°F to 77°F)
Allowable temperature range during machine operation: 0°C to 40°C(32°F to 104°F)
- (7) To maintain static machine accuracy at levels even higher than the standard guaranteed values :
 - a) Keep the ambient temperature variance for 24 hours (1 day) within $\pm 2^{\circ}\text{C}$ (36°F).
 - b) Ambient temperature variances from floor level to a height of about 5 meters(16.4ft) should be held within 1°C(34°F).
- (8) Dynamic load (acceleration, inertia, vibration) is not relevant respect to static load (machine weight).

2.2 Care in handling a precision machine

This model is built in one unit and it can be easily moved without separating it into consisting units. (Note that the coolant tank is installed separately.)

Lifting and moving machine :

There are three different methods for moving the entire machine to any desired location; by an overhead crane, moving by a forklift truck and using lifting hooks supplied together with the machine and by rolls over which the machine is pushed by manual labor.

(1) Machine lifting

Procedure :

- 1) Move all axes to their end position. And move the tailstock(or sub-spindle) to the right end and clamp it.
- 2) Remove any work pieces, tools etc out of inside the machine.
- 3) Turn off the power supply to the machine and disconnect the power cables and other hoses with the machine.
- 4) Pull the coolant tank out of the machine.
- 5) Place the leveling blocks at the planned place.
- 6) Fix the lifting bar at the predetermined positions.
- 7) Fasten the screws on the lifting bar
- 8) Lift and transport the machine with the crane.
- 9) After affirming the leveling bolts are all placed at the correct positions, lower the machine slowly and carefully.

2.3 Cautions for installation

At installation, the following points should be checked in order to ensure high accuracy and performance.

- 1) We recommend appropriate foundation work where the soil is soft or apt to sag after initial installation.
- 2) The installation site should be kept as far as possible from vibration sources, such as roads, stamping, press type equipment, or planer type machine tools. If nearby sources of vibration are unavoidable, dampening pits around the machine foundation, for example, should help lessen vibrations.
- 3) Where there are high-frequency power generators, electric discharge machines or electric welding machines around or when power is supplied from the same shop power distributor panel, electrical interference may cause NC malfunctions. For assurances, consult out service engineer dispatched for the installation.

- 4) The ambient atmosphere of the machine must avoid high temperature (35°C or above), high humidity, and a lot of dust. Do not expose the machine to strong, direct sunlight or heat from a heater, or local thermal displacement will cause low accuracy and unreliable operation.
- 5) The ideal operation environment calls for an ambient temperature of 20°C with humidity between 40 to 75%.
- 6) Keeping ambient temperature at a constant level is an essential factor for accurate machining.
- 7) In order to maintain static machine accuracy within guaranteed values,
 - ① the machine should be installed in an area where it is not affected by air flow.
 - ② Air conditioning is not essential, but an ambient temperature between 17°C and 25°C is recommended.
 - ③ Keep ambient temperature variance for a full day or 24 hours within $\pm 2^{\circ}\text{C}$.
 - ④ Ambient temperature variances from the floor level to a height of the machine should be held within $\pm 1^{\circ}\text{C}$

2.4 Foundation

With a solid ground, a concrete floor about 350 mm (15.51 inch) thick and no gaps between ground and floor, foundation work or anchoring is not required

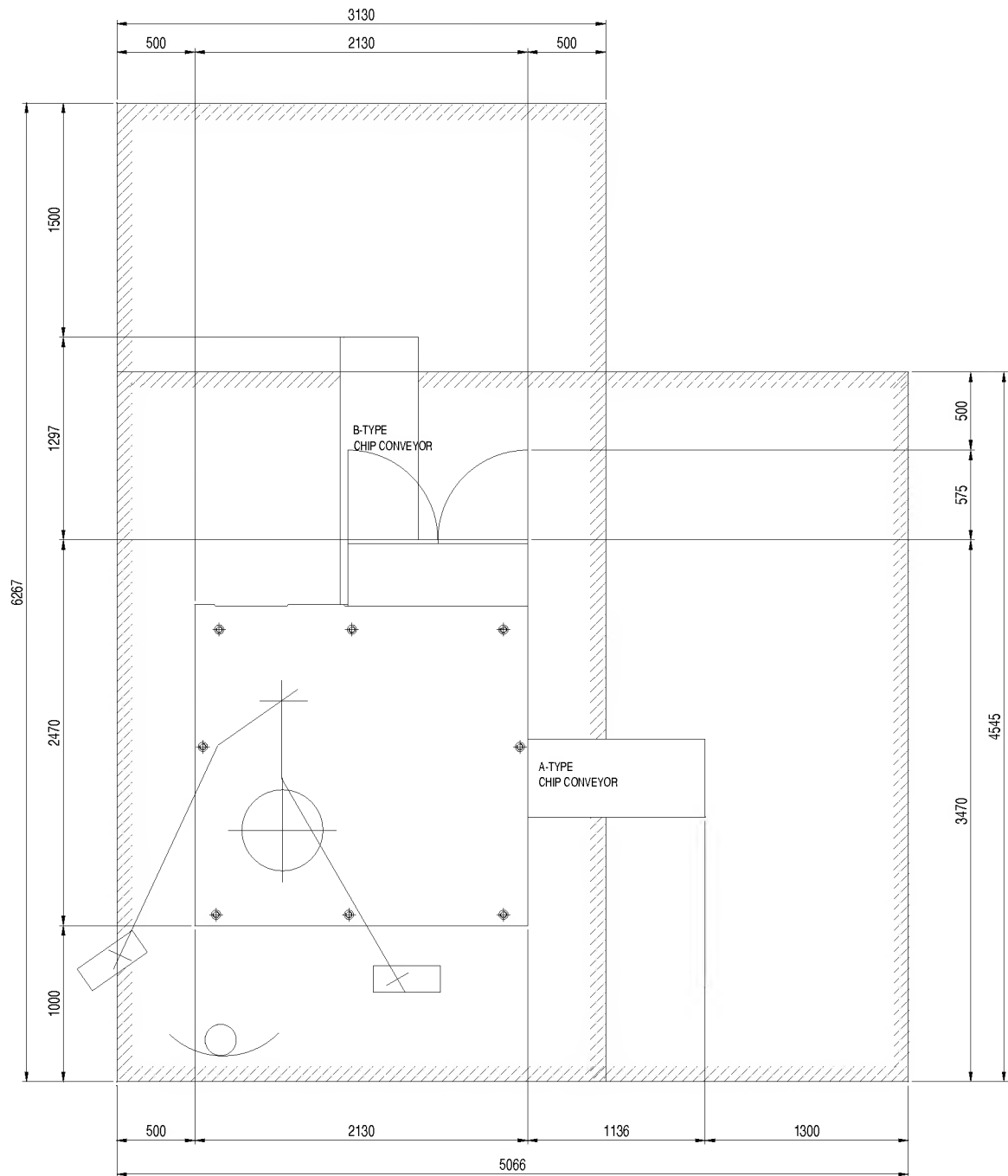
The structural rigidity of the machine permits normal machining. The use of foundation bolts is not required, either.

However :

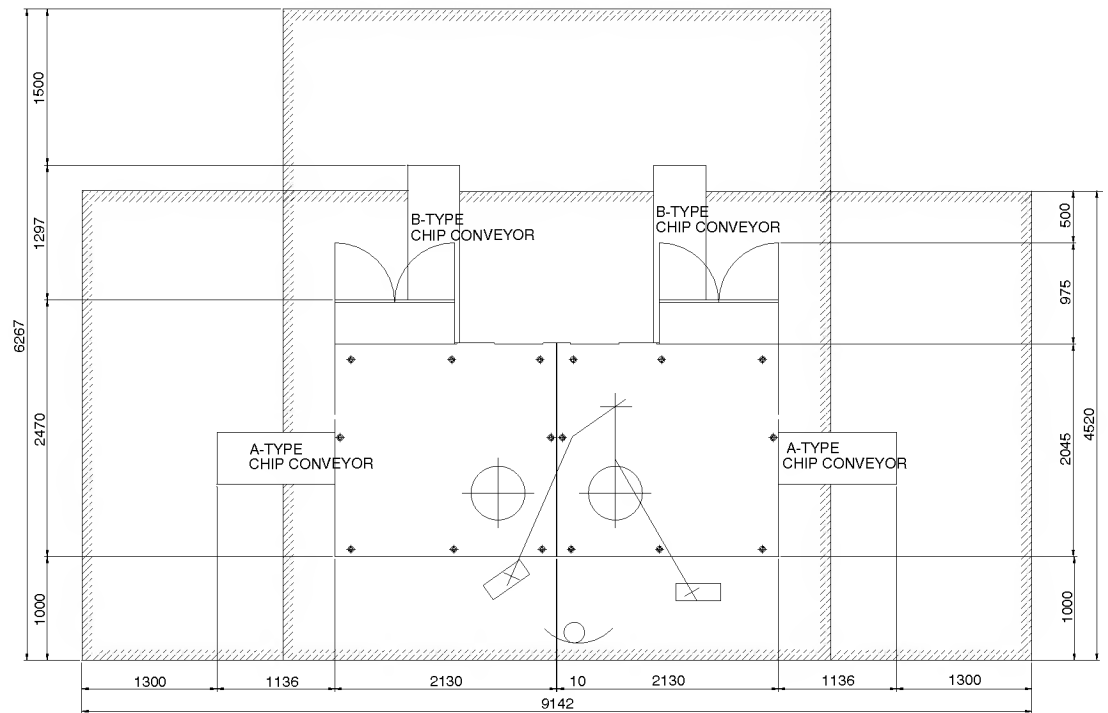
- ① For higher accuracy and performance,
- ② To maintain high accuracy and prolong intervals between periodical maintenance,
- ③ When the ground (type of soil) is not strong enough, refer to the provided 2.2.1 INSTALLATION PLAN, 2.2.2 FLOOR FOUNDATION PLAN, 2.2.3 FOUNDATION WORK PLAN for proper installation.

1. Installation plan

1) PUMA VT900/M

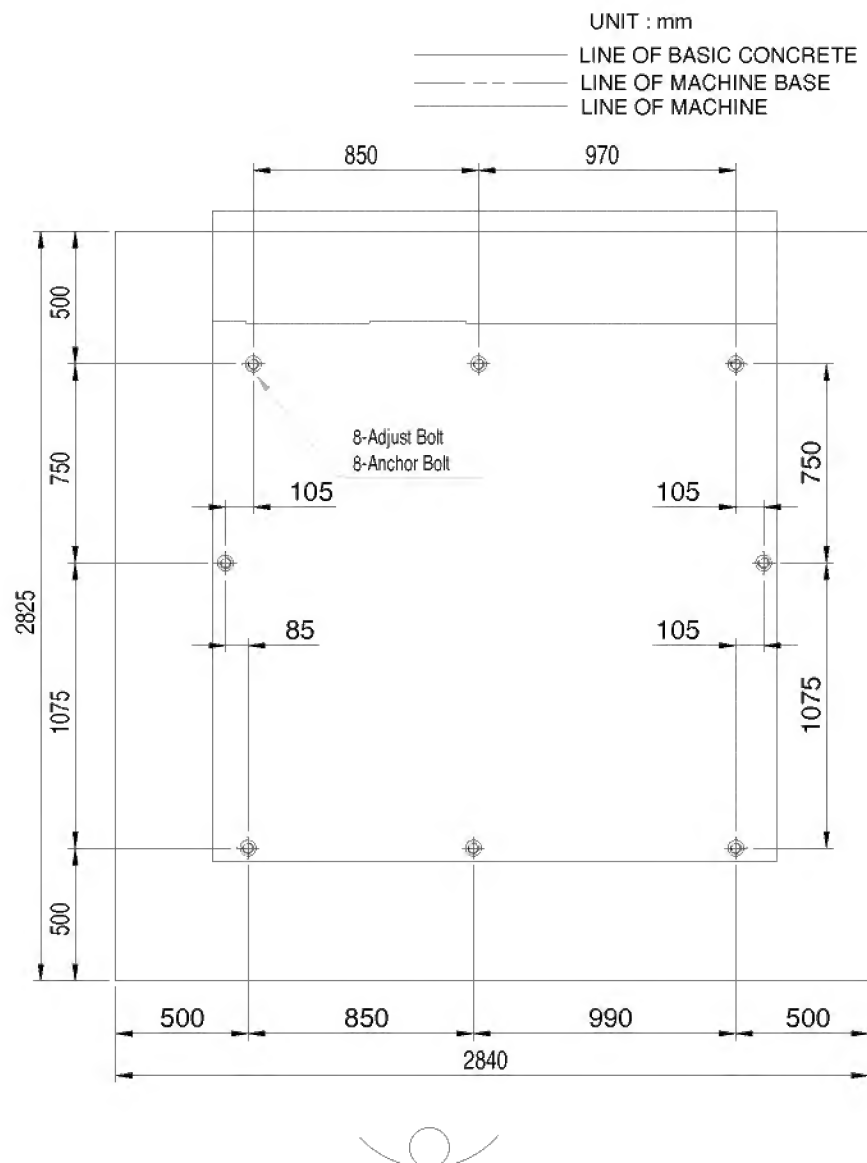


2) PUMA VT900-2SP/M-2SP



2. Floor foundation plan

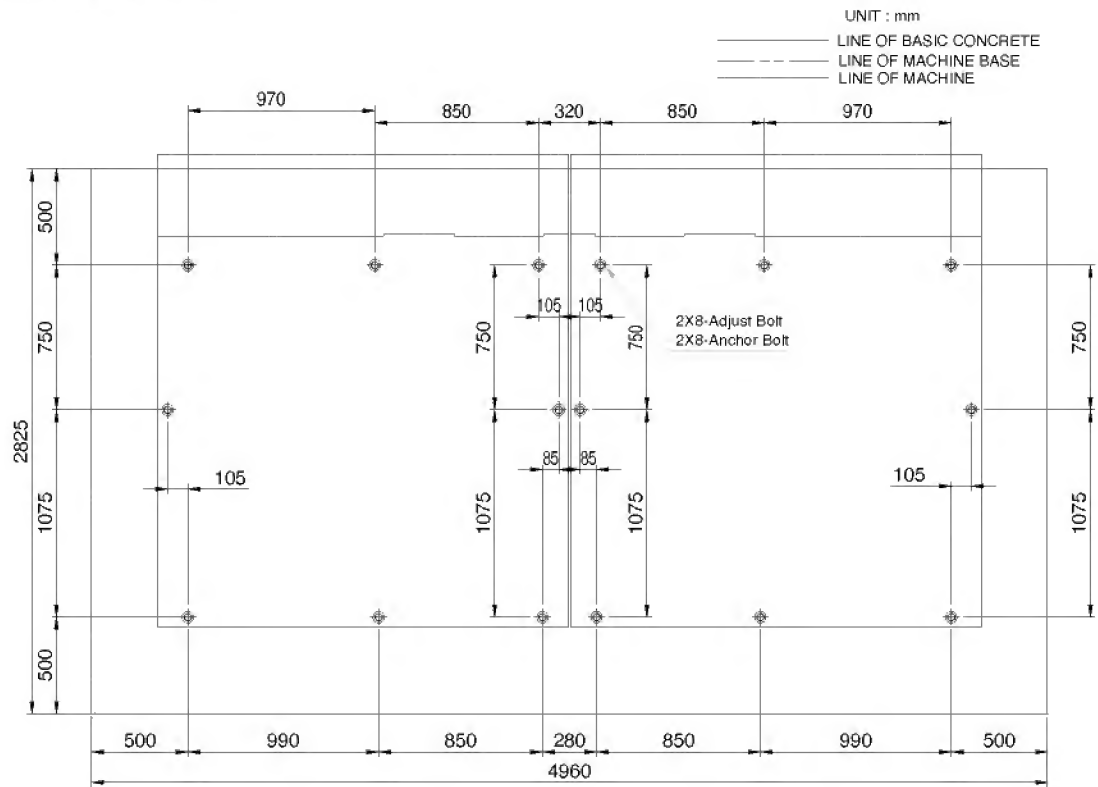
1) PUMA VT900



Weight and estimated value of surface pressure	
Machine Weight	12,500 Kg
Foundation Concrete Weight	7,800 Kg
Average Pressure at the bottom side of foundation concrete	2.8 ton/m ²
Required ground durability	3.6 ton/m ²

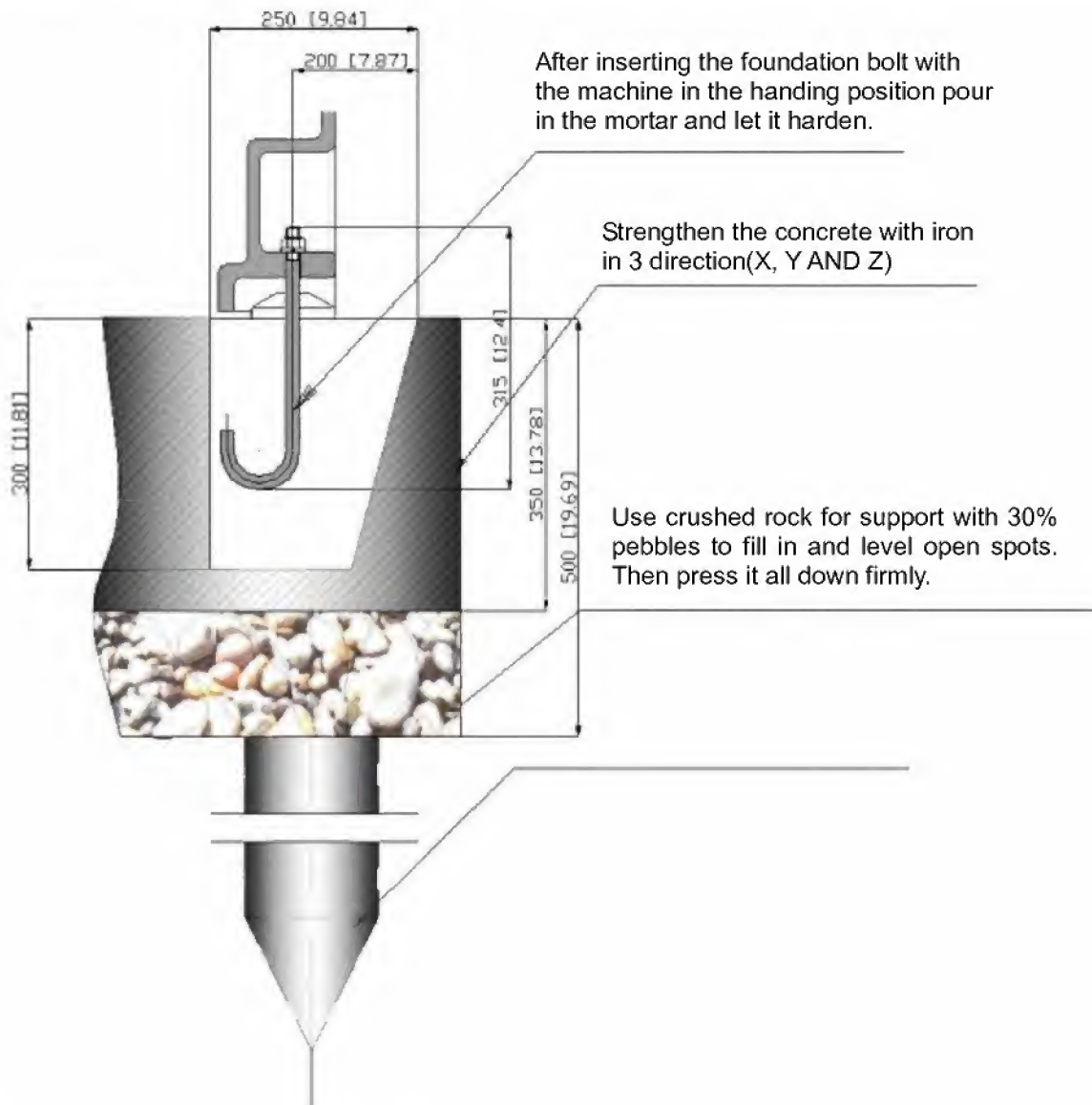
※ The machine weight includes the chuck, tool holder, chip conveyor and other pieces of standard equipment.

2) PUMA VT900-2SP



Weight and estimated value of surface pressure	
Machine Weight	25,000 Kg
Foundation Concrete Weight	13,460 Kg
Average Pressure at the bottom side of foundation concrete	2.8 ton /m ²
Required ground durability	3.6 ton/m ²

※ The machine weight includes the chuck, tool holder, chip conveyor and other pieces of standard equipment



OBSERVANCE

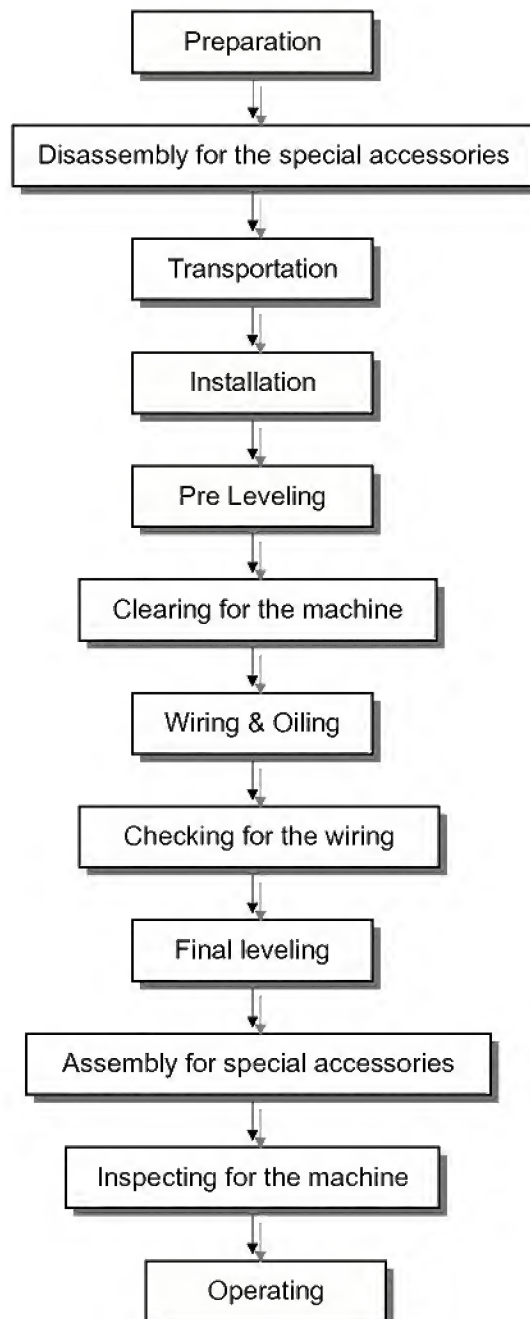
- 1) This plan only shows the general standard.
Please adjust the thickness of the concrete according to the ground condition.
- 2) The foundation bolts, nuts and iron plate are not standard parts
- 3) It is advisable to use vibration resistant walls when some other machines in the area cause vibrations. Horizontal difference of the surface of the foundation concrete should be 10 mm or less.

✱ The foundation bolts, nuts and iron plate are not standard parts.

2.5 Transportation and Installation

⚠ WARNING

- Transportation and installation of the machine should be carefully done according to the following order for the worker's safety and the damage prevention of the machine.
- When use the crane, work after confirm the safety of circumstance.



1. Preparation

Prepare for transportation of the machine in the following sequence.

- 1) Put in the carriage and sub spindle to the middle of the machine, and fix them securely.
- 2) Fix X, Z-slide plates with locking plate.
- 3) Drain the hydraulic oil, lubricant and coolant.
- 4) Fix the splash guard so that it does not move during transportation.
- 5) Disconnect the power cables.

2. Disassembly

Remove the following parts from the machine

- 1) Chip conveyor (optional)
- 2) Another unfixed unit (optional)
- 3) Coolant tank and coolant pump

3. Transportation

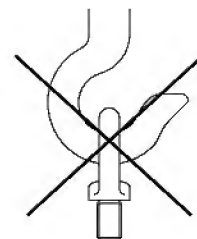
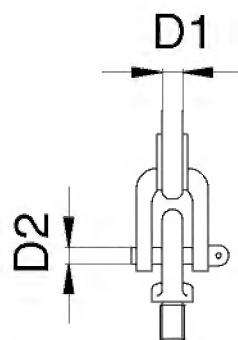
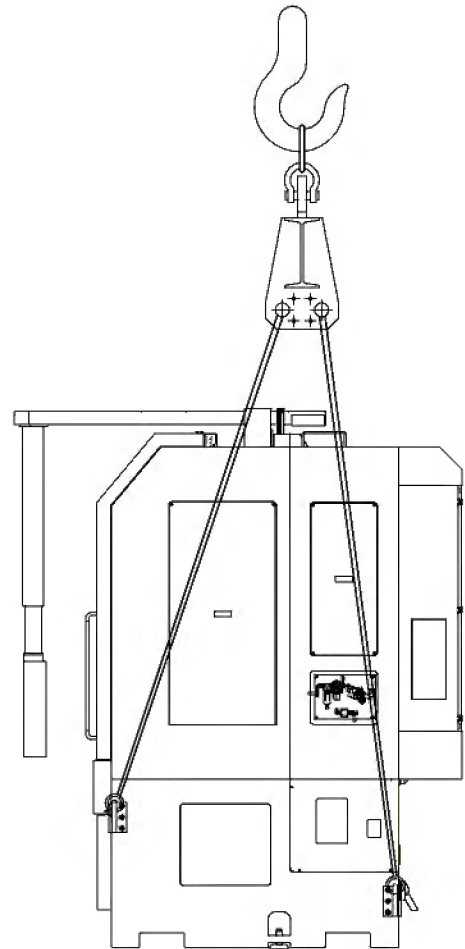
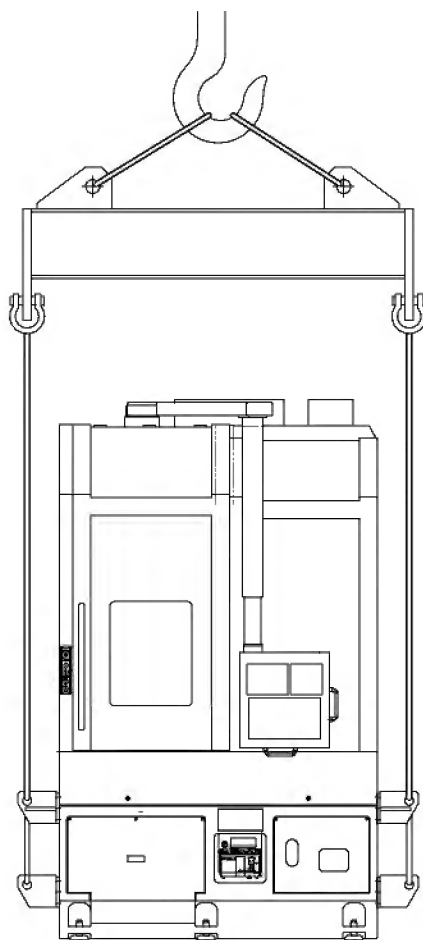
It is recommended that this machine be transported with a Crane and attention should be paid for the followings.

WARNING

- 1) Hoisting work with a Crane should be done by the person who has a driver's license for Crane.
- 2) To hoist up the machine, use the jigs such as wires, rope, shackles and lifting jigs which can endure the weight enough, according to the specified method.
- 3) Confirm that each part of the machine is fixed before it is lifted up.
- 4) Confirm that there have been any needless things like tools or wedges in the machine.
- 5) Confirm the balance of front/rear and right/left with the machine lifted up a little.
- 6) When more than 2 persons work together, be sure to tune the signals one another.
- 7) Refer to the drawing of lifting up for the weight of machine body and the wire rope.
- 8) To lift up the machine, use a lifting jig.
- 9) Use a pad or a block of wood so that the wire rope might not contact directly with the machine.
- 10) Be sure that the angle between the lifting hook and the wire rope is not too high.
- 11) Be sure that the machine is not inclined while hoisting it up.
- 12) Hoist up the machine slowly and stop it when the rope is tightly pulled. And then confirm the fixed status of the rope and lift it up to the required height.
- 13) Hoisting down should also be done slowly, and stop before it contact on the ground. Then, confirm the position and get it down.

< Lifting >

<PUMA VT900>



⚠ WARNING

	MACHINE WEIGHT	WIRE ROPE D1	SHACKLE D2
PUMA VT900/M	12,500kgf	Over Ø32mm	Over Ø48mm
PUMA VT900-2SP /M-2SP	25,000kgf	Over Ø32mm	Over Ø48mm

4. Installation

Place the machine on the specified place and insert the attached mounting plate at the adjust bolt positions.

5. Leveling

After installation, temporary leveling is executed according to the following.

<Procedure>

- 1) Install a leveling gauge to X direction on the slideway of base.
- 2) Adjust the right and left level confirming the status of the leveling gauge
- 3) Install a leveling gauge to Z direction on the slideway of base.
- 4) Adjust the front and rear level confirming the status of the leveling gauge
- 5) Adjust the level using leveling bolt confirming level.
- 6) Adjust with leveling bolt so that the space from the bottom side of machine to the ground will be within 10mm.

6. Cleaning for the machine

After leveling is completed, clean the machine as the following.

Rust preventative is applied to the machine prior to shipment. Since sand and dust may enter the rust preventative during the transportation, do not operate the feed shaft before cleaning.

The foreign substances may be caught in the gap.

- 1) Remove the fixing tool for the delivery
- 2) Polish the machine carefully using smooth cloth with clean petroleum.
- 3) Apply the lubricant lightly on each finished surface.



Do not use air gun. It is concerned that pollutants gotten into the gap due to the air pressure may damage the surface of the gap.

7. Wiring and Oiling

A. Power supply

Power supply to the machine is as follows.

1) Electric power----- AC 200/220 V $\pm 10\%$, 50/60Hz $\pm 2\%$

2) Power consumption----- PUMA VT900 :75 kVA

VT900M : 80kVA

VT900 -2SP : 145kVA

VT900M-2SP : 155kVA

3) Cables----- 22 mm² (0.34in²) compatible

If main electric power to supply to the machine is not AC200/220 V, Set up the special transformer.

B. Oiling

Feed the designated lubricant, hydraulic oil and coolant to the parts of machine.

C. Wiring for the machine

Wire the cables from the electric power opening, confirm that the revolution of the fan motor for the spindle is normal, then, fasten the bolts for the terminal block securely.

Check the rise of hydraulic pressure. (40kgf/cm²)

D. Grounding(Earth)

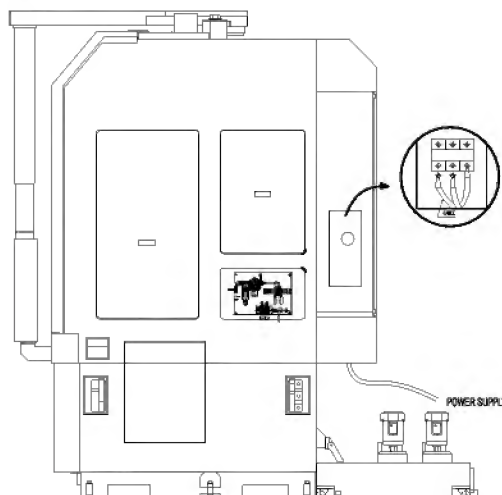


Grounding should be executed by the person who has a license to prevent an accident due to an electric leakage and malfunction of control system due to electric noise.

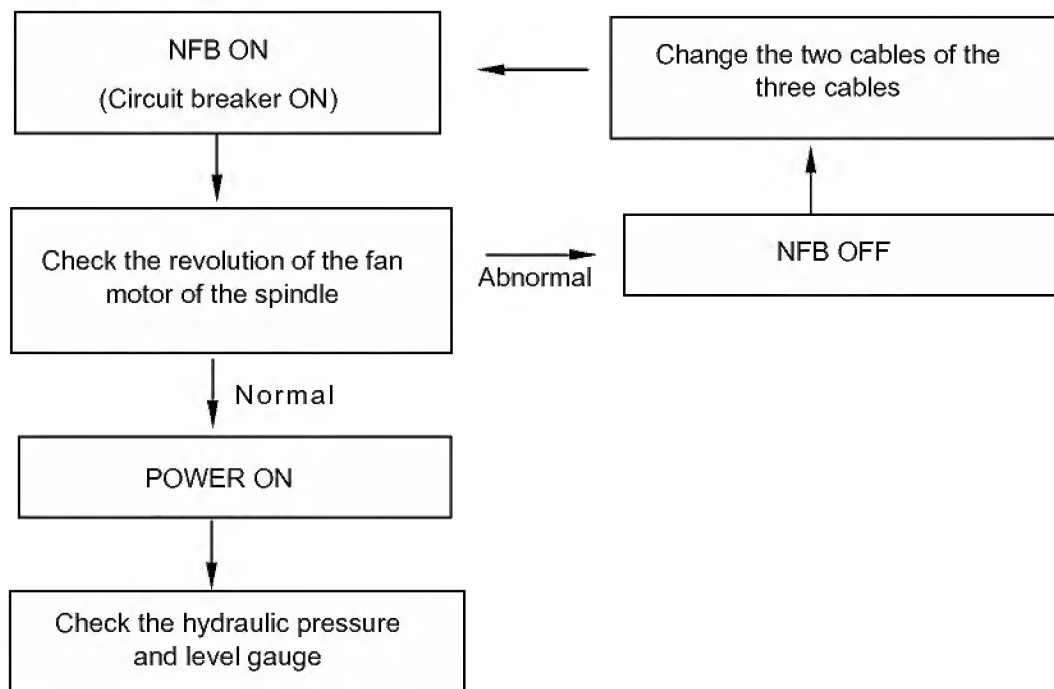
1) Earth wire should be as short and thick as possible like input wire. (3rd-class, Earth resistance is less than 100Ω.)

2) Grounding should be independently and certainly done. There may be the earth wire of electric welding machine or electrical discharge machine contacting with the iron frame of factory. Be sure that it never happens.

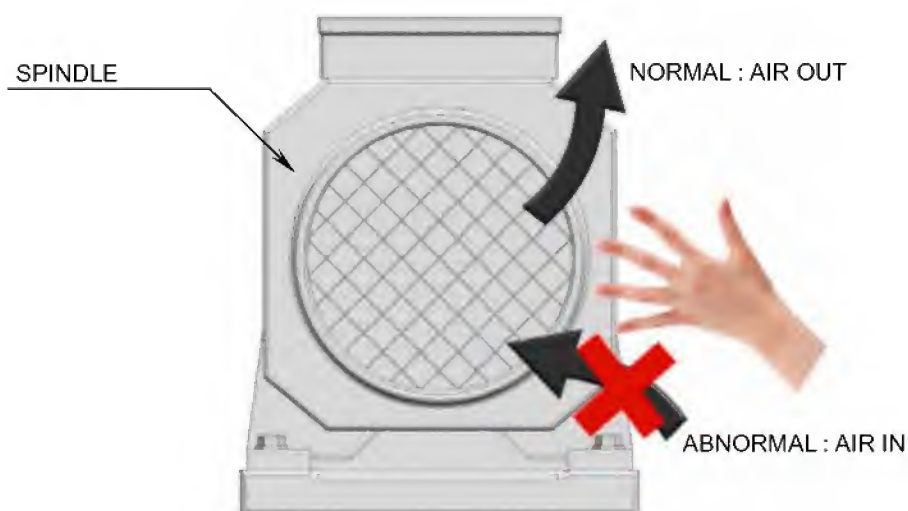
E. Method for wiring



8. Check the wiring



- Method for checking the revolution



9. Assembly for special accessories and another accessories

Wiring and piping for the chip-conveyor, bar-feeder and another accessories with the designated connectors and joints.

10. Inspecting for the Machine

After installation and wiring are completed, confirm all functions, arrange the surroundings and confirm the level one more time.

2.6 Removal of the transit clamps

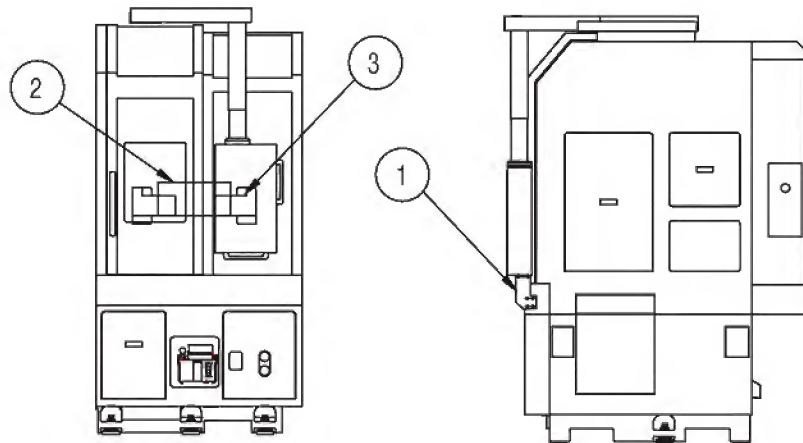
When the machine is shipped, the transit clamps are installed in order to fix each of axes.
After the installation of machine, be sure to remove each of the transit clamps.

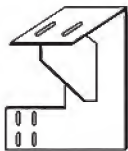
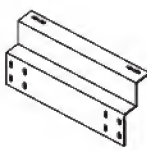
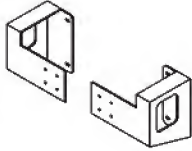
NOTICE

- 1) Before operating the machine, be sure to disassemble the transit clamps.
- 2) If operating the machine without removal of transit clamps, a severe damage may be brought on the performance of machine such as machining accuracy and so on.

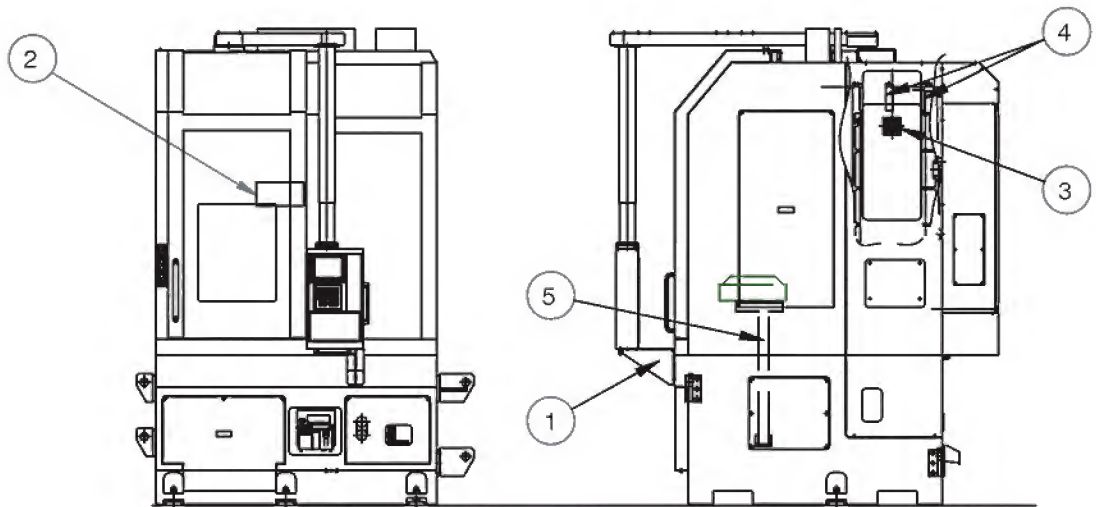
Location of transit clamps






<PUMA VT900>



<p>1</p> <p>O/P BOX</p> <p>Lower of Machine</p>		<p>2</p> <p>X-Axis</p> <p>Inside of Machine</p>		<p>3</p> <p>Z-Axis</p> <p>Inside of Machine</p>	
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<PUMA VT900-2SP>



<div>1</div> <div>O/P BOX</div> <div>Lower of Machine</div>		<div>2</div> <div>X-Axis</div> <div>Inside of Machine</div>		<div>3</div> <div>Z-Axis</div> <div>Inside of Machine</div>		<div>4</div> <div>Z-Axis</div> <div>Top of Column</div>		<div>5</div> <div>Z-Axis</div> <div>Inside of Machine</div>	
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2.7 Power connection

The machine electrical power connection must be done on charge by customer, he has to consider :

- laws and technical norms in force for the installation place
- all of the data specified on CE main plate

The power cable input on electric cabinet is provided by cable gland, there is also L1, L2, L3 (three phase voltage) terminal and PE (ground connection) terminal as shown in the next standard diagram, for precise and specific information please check the machine original electric diagram book.

The machine is provided for connection to power net system TN (TN-C or TN-S), and respect the Test 1 of EN 60204-1:2006 – part 18.2.2.

For right safety level against accidental voltage contact on power net systems like TT or IT the customer must install a protection system according to ground line; as described in EN 60204-1:2006 – part 18.2.1, the customer can follow the IEC 60364-6-61.

These information joined with CE main plate data give all of the necessary knowledge for the correct power line dimensioning, protection for and machine connection and users..

NOTE

The power cable section can't be calculated without knowing the final line length, but anyway it must be greater than 3 numbers of 22mm² Copper wire or equivalent material.

2.8 Connection to smoke extraction system

Machine work with use of coolant may produce smoke and fog dangerous for body health, so the machine is provided with a vacuum cleaner connection.

Vacuum cleaner and machine pipe connection must be done by customer, the hole for connection normally is point A (signed in the picture) or in the upper part of the cover.

3. Lubrication system

Lubrication system is for the sake of making up oil film on the Slide Ways of machine and preventing wear on the Slide Ways while the cross slide of carriage is operated smoothly. This system consists of a lubrication oil pump unit, a distributor and piping parts. There are float s/w and pressure s/w are installed in the inside of the tank. If the oil in the tank is reduced or the projection pressure is changed, it is checked and displayed on the CRT screen. Lubrication projection is executed by the pump which is automatically and intermittently operated by the programmable controller. The oil sent from the pump flows into the distributor in which the oil is measured, and distributed to each lubrication point.

3.1 Head Stock

The spindle bearing contains special long-life grease for lubrication, and so it requires no servicing under normal operating conditions.

3.2 X- and Z-axis Slideway

This part receives forced constant quantity lubrication by the automatic intermittent oiling pump. Discharge interval of the pump is set to about 15 minutes by the timer.

OBSERVANCE

As the oil level in the lubricant tank gradually decreases, refill it as required. When the oil level falls below the specified level, the alarm sounds.

3.3 X- and Z-axis Ball Screws

An automatic intermittent lubrication pump performs automatic oiling. The lubrication tank is the same as X/Z axes slideways

3.4 X- and Z-axis Feed Box

An automatic intermittent lubrication pump performs automatic oiling. The lubrication tank is the same as X/Z axes slideways

3.5 Tool Post

An automatic intermittent lubrication pump performs automatic oiling. The lubrication tank is the same as X/Z axes slideways

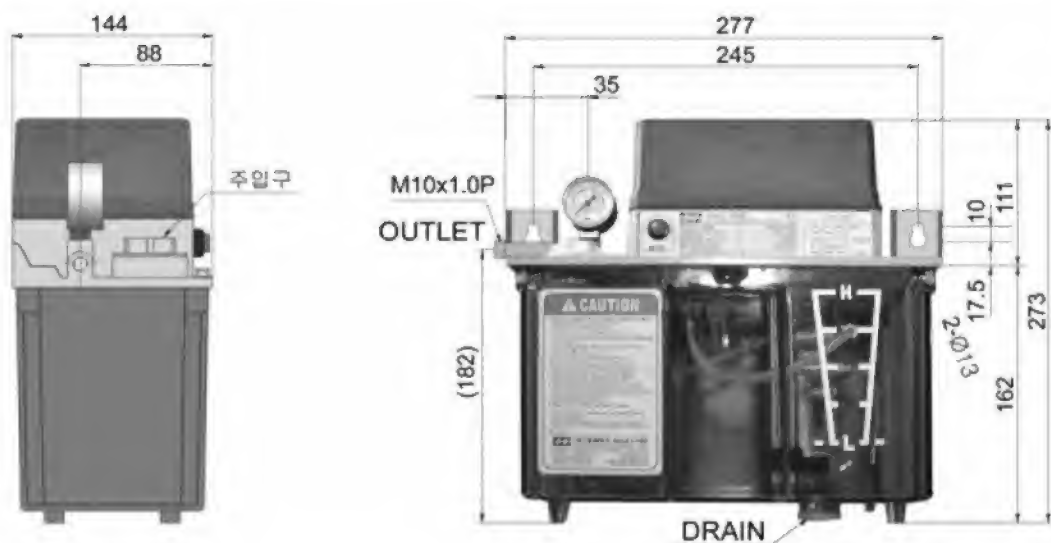
3.6 Recommended Oil & Grease

No.	Position to be supplied	Name			Remarks	
		Esso	Shell	Mobil	PUMA VT900	PUMA VT900M
1	Spindle bearing				Grease NBU15	
2	Hydraulic unit	Teresso 32	Tellus Oil C32	DTE Oil Light	10liter 4liter	10x2liter 4x2 liter
3	Lubrication tank			Vactra No.2		
4	Coolant tank (Chip pan)	Cutwell 40, Stancool S518	Dromus Oil B, Dromus Oil F	Solvac 1535G	PUMA VT900	PUMA VT900-2SP
					400 liter	400x2 liter
5	Air service unit	Teresso 32	Tellus Oil C32	DTE Oil Light	Option	

3.7 Lubrication unit

1. Lub. Unit specification & dimension

Pump		Gear Pump
Discharge pressure		17 kg/cm ²
Pressure Gauge		0-35 kg/cm ²
Using oil		32-1,300 cSt
MOTOR	Output	46 W
	Voltage	1ØAC 2000V/220V
	Current	0.55A (220V)
Tank capacity		4 liter
Remark		Outside



2. Supplying oil manually

CAUTION

After the machine has been stopped for a long time, there might not be an oil film on the slideways. If machine operation is started with the slideways not lubricated proper, the slideways and ball screws might seize.

< PROCEDURE >



- 1) Turn on the power.
- 2) Make sure that the lubricating oil tank is filled with oil.
- 3) Push the manual button one time.
- 4) When the pressure gauge is zero, push the button once more.

OBSERVANCE

Never PRESS down the button more than 1 minute

- 5) Repeat steps 3) and 4) until the slideways are



Press manual button

3. Lubrication confirmation of operating side

<Confirmation method>

- 1) If the machine has been stopped for long time, it might be considered that the space from distributor to oil supplying line of the pipe is empty.
- 2) Confirmation should be done directly in front of the pipe of operating side etc. Touch the side with finger tip to confirm whether there is oil film or not.
- 3) Loosen the pipe occasionally to confirm the lubrication oil flows out.

4. Cleaning of lubrication tank



- 1) Cut off the power source.
- 2) Open the cap as the figure
- 3) Loosen the bolt 2EA on the upper surface of lubrication oil tank and open the tank.

OBSERVANCE

While the tank is removed, be cautious that the lubrication

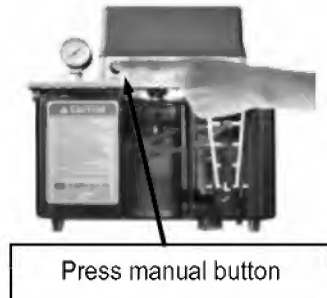


- 4) Clean the inside of tank.
- 5) Take out the suction filter at the suction opening.
- 6) Wash the suction filter with petroleum.
- 7) Execute air blowing for the suction filter.
- 8) Take out the filter of oiling opening.
- 9) Wash the filter of oiling inlet.
- 10) Attach the Suction.
- 11) Attach the filter of oiling inlet.
- 12) Attach the Tank.
- 13) Close the cap



5. When supplying pressure doesn't go up.

< Confirmation method >



- 1) Press the manual lubrication oil button.

OBSERVANCE

Do not press it for more than 1minute

- 2) Confirm that the pressure gauge reaches 8~10kg/cm².
- 3) Confirm that the pressure gauge reaches 0 kgf/cm².

Repeat the procedure 1) to 3) to confirm that the pump works normally.



< When the pressure doesn't go up >

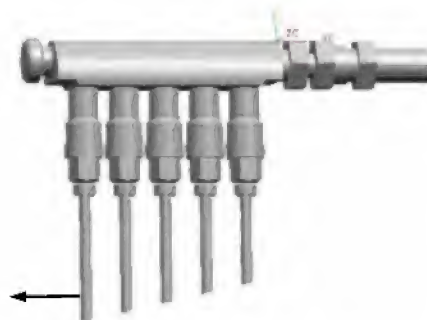
- 1) It might be considered that the pipe of distributor is cut or oil is leaked. Check it, and then if the pipe has been cut, replace it and if it is loose, tighten it.
- 2) It might be considered that the Relief Valve is malfunctioning. After disassembling it, If the valve or seat is worn or cracked, it should be replaced. And there is a foreign substances, cleaning should be done.

6. When air got into the pipe

Confirm the cause of air inflowing.

- 1) Insufficient amount of oil in the tank.
- 2) Damage of the pipe
- 3) Breakdown of the Float Switch

< Air discharge procedure >

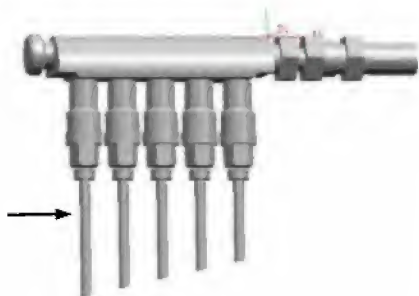


- 1) To remove the air in main pipe, loosen the plug of the final distributor at lubrication oil circuit.



Press manual button

- 2) Press the manual lubrication button to remove the air in main pipe.



- 3) Remove the air in Main pipe and attach the plug.

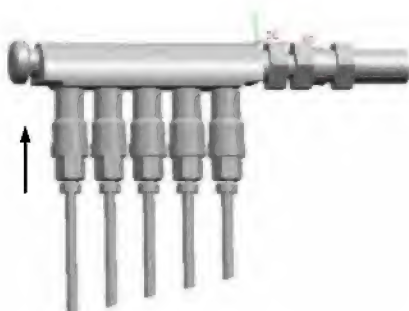


- 4) Loosen the plug of branch pipe.



Press manual button

- 5) Press the manual lubrication oil button to remove the air from the inside of distributor.



- 6) Arrange the branch pipe.

7. When the lubrication oil in the tank is not reduced

< Confirmation method of Pump discharging amount >



- 1) Loosen the flexible hose from the discharge opening of pump.



Press manual button

- 2) Push the manual button one time.
- 3) Check the discharge of lubricant.

< If the discharged amount for 50 second is less than 100~120cc >

- 1) it is possibly considered that the chink of Suction Filter is blocked.
→ Clean the suction filter in the tank.
- 2) it is possibly considered that the suction capability has been deteriorated due to wear of the pump inside.
→ Replace the pump with new one.

8. When lubricant pressure low alarm is displayed

If the pressure doesn't get to over 8kgf/cm² within 1 minute after the lubrication oil pump get started, pressure S/W operates and Alarm (R side:2030, L side: 2130) is displayed on the screen.

< Cause >

- 1) Oil leaks in the piping part or the pipe is cut off. Check the pipe.
- 2) The chink of Suction filter is blocked and the status of suction is bad. Clean the suction filter.
- 3) Breakdown of the motor. Replace it with a new one.
- 4) After confirmation of the above causes and checking & repairing are carried out, press the "RESET" key of operation panel to release the alarm.

9. When alarm is displayed(Lubricant oil low level)

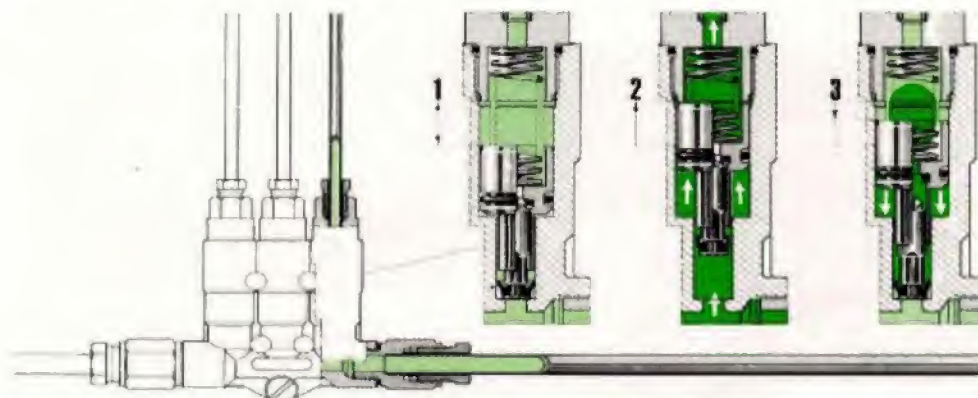
If the lubrication oil in the tank is reduced to less than the specified level, the float S/W gets started and Alarm(R side:2030, L side: 2130) is displayed on the screen. Then the cycle is locked and automatic operation doesn't get started.

< Release method >



1) Supply lubrication oil to release the Alarm.

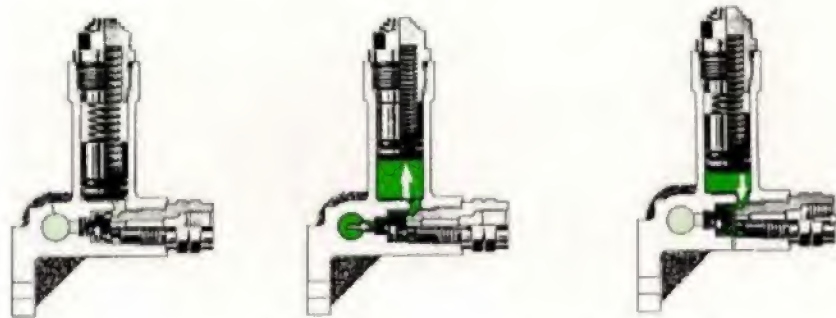
10. Distributor



1) Main pipe caliber M10

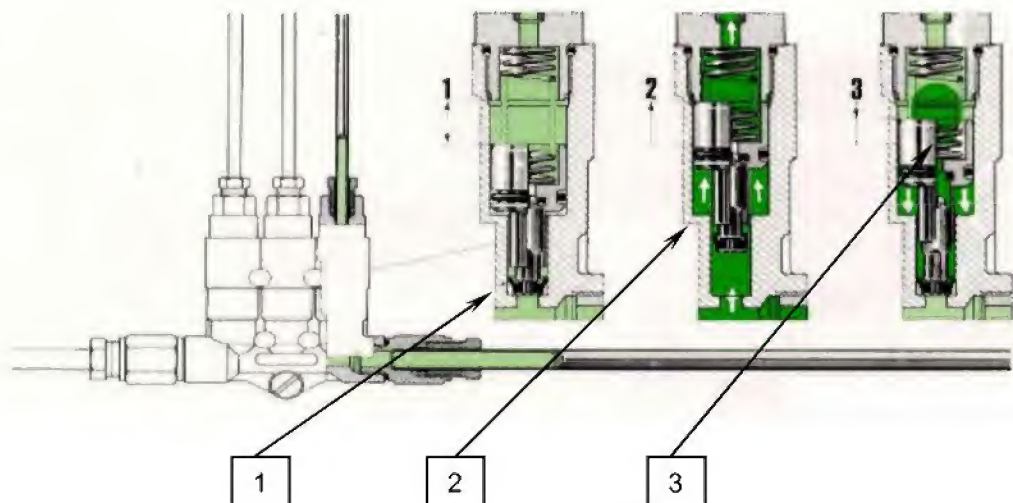
Type	Piston-operated
Main pipe caliber	M 10 tap P:1.0
Branch pipe caliber	M 8 tap P:1.0
1 time discharge amount	Recorded on the cap

2) Main pipe caliber M12



Type	Piston-operated
Main pipe caliber	M 12 tap P:1.0
Branch pipe caliber	M 8 tap P:1.0
1 time discharge amount	Recorded on the cap

3) Principle of lubrication operation



- 1) While the power is on, the pump operates for 50 seconds per 15 minutes by the timer of programmable Controller.

Note) At the moment that the power is on, the pump operates for 50 seconds.

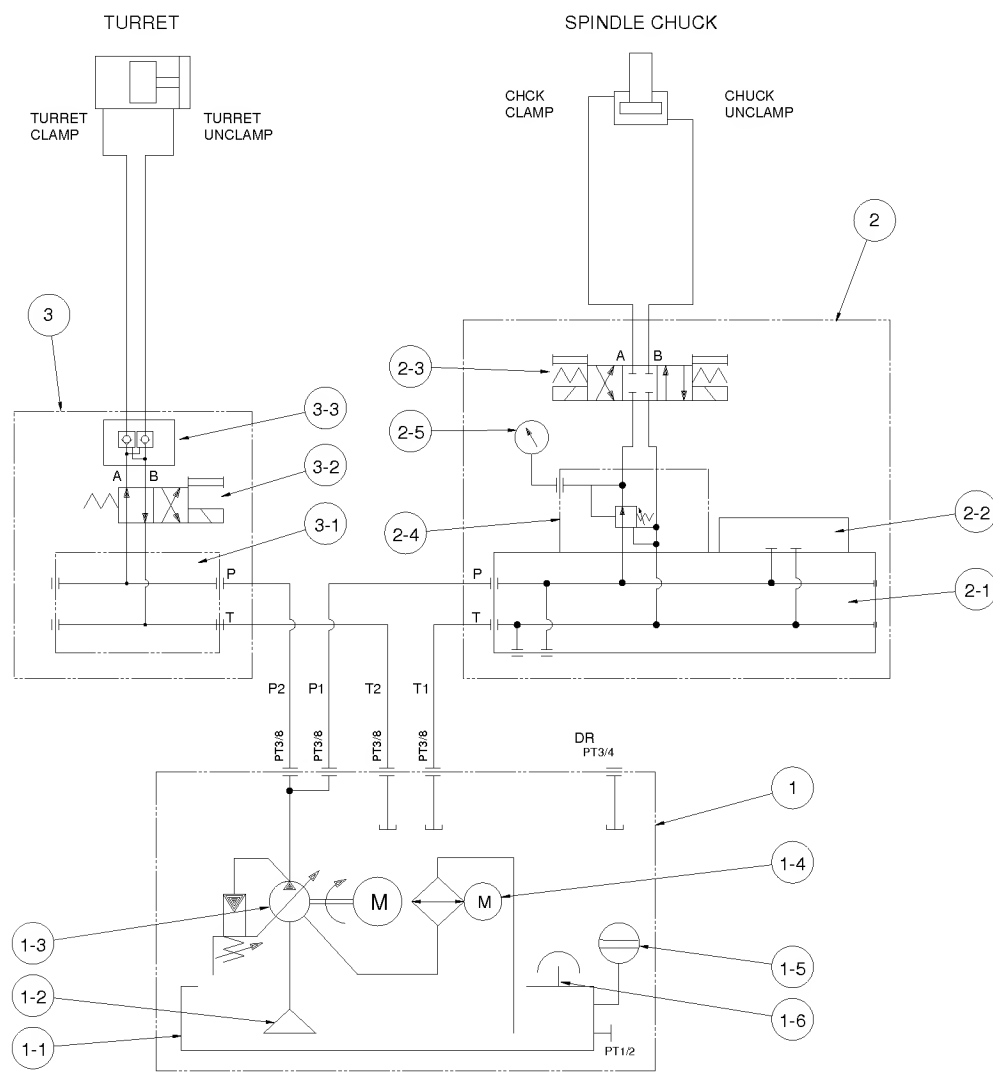
- 2) The lubrication oil in the tank comes up from the pump and flow into the distributor through the main pipe.
- 3) Due to the pressure in the pipe increased, oil comes up and pushes the valve ①.
- 4) At the same time, it comes up and pushes the sleeve ② and discharges oil in the cylinder on the top to the branch pipe.
- 5) Even if the pump stops, the pressure only in the pipe decreases by the depressurizing tool, and the sleeve is returned because it ② is pushed by the force of spring ③.
- 6) At this time, oil flows into the oil chamber through the upper hole of the valve ① supported under the cylinder. Then the operations of 1) ~ 6) are repeated.

4. Hydraulic system

4.1 Hydraulic circuit

Hydraulic circuit is attached as the figure below.

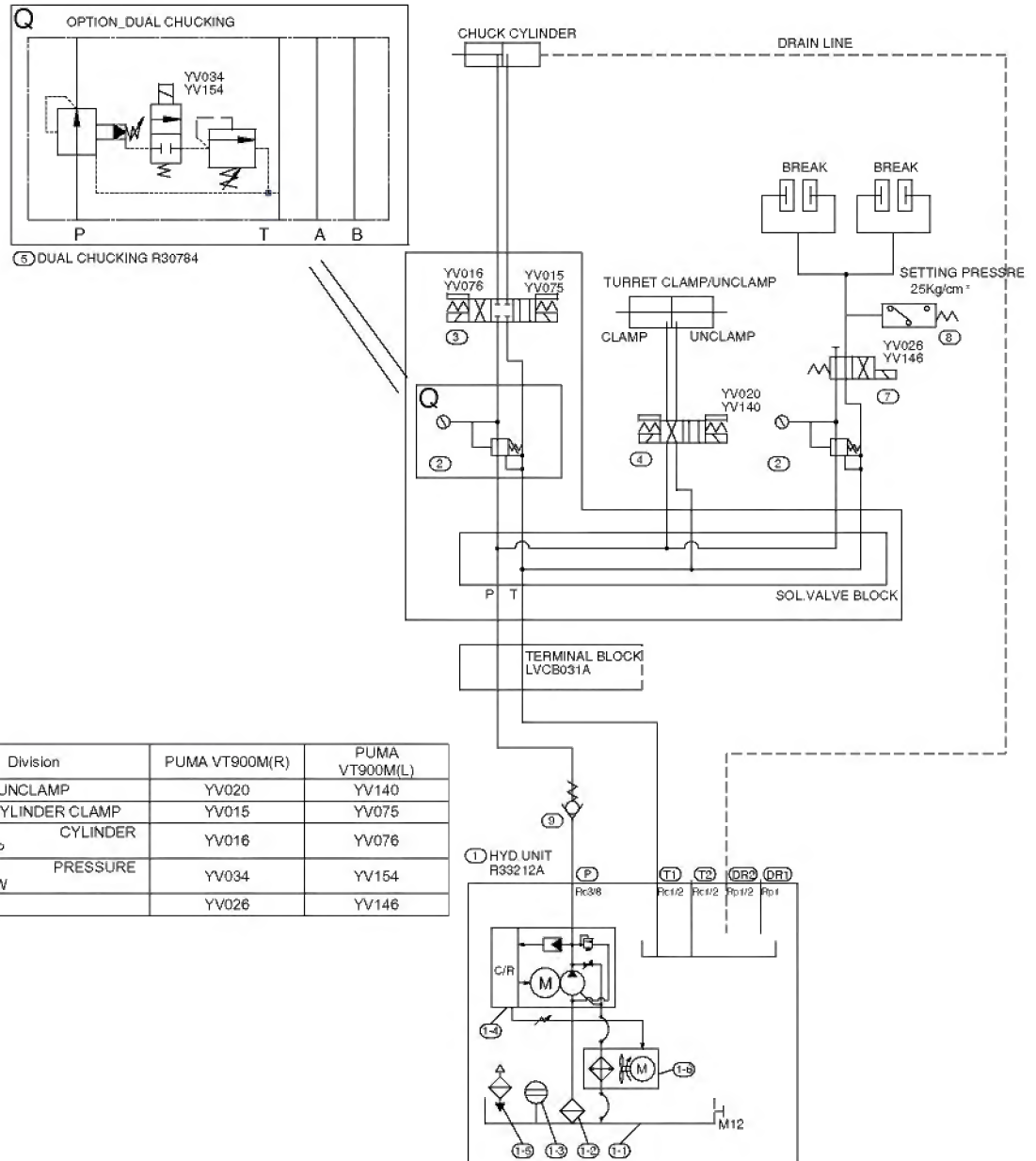
1. PUMA VT900 /PUMA VT900T



NO.	DRAWING NUMBER	PART NAME	SPECIFICATION	Q'TY	REMARK
1	R33212A	HYD. POWER UNIT		1	DAIKIN
1-1		OIL TANK	10L	1	DAIKIN
1-2		SUCTION FILTER	DHA-06-150	1	TUKASA
1-3		PUMP SET		1	DAIKIN
1-4		COOLER	1734294-02	1	DAIKIN
1-5		LEVEL GAUGE	KLA-80A	1	KYOWA
1-6		AIR BREATHER	HY-06T	1	DAIKIN
2		MANIFOLD ASS'Y		1	IL RIM
2-1		MANIFOLD	01-2	1	IL RIM
2-2		END BLOCK	L36351023A	2	IL RIM
2-3		SOLENOID VALVE	D1VW20KNJPF	1	PARKER
2-4		REDUCING VALVE	MPRV-3-PP-07-K-N-10	1	PARKER
2-5		PRESSURE GAUGE	60X60bar(A)		WIKA/N.F
3	AHC083A0	MANIFOLD ASS'Y		1	IL RIM
3-1		MANIFOLD	01-1	1	IL RIM
3-2		SOLENOID VALVE	D1VW20BNJPF	1	PARKER
3-3		PILOT CHECK VALVE	MCVP-3-D-N-10	1	PARKER

2. PUMA VT900M / PUMA VT900M-2SP

No	Name	Item	Remark	No	Name	Item	Remark
3	SOLENOID V/V	DSG-01-3C2-D24-N1-50	YUKEN	1	HYD. UNIT	EHU25-M07-AE-30-V-162	DAIKIN
4	SOLENOID V/V	DSG-01-2D2-D24-N-60	YUKEN	1-1	OIL. TANK	10L	DAIKIN
5	TWO PRESSURE SETTING RED V/V	TMPRV-3PP-35/1.5-K-N- J-K5844	YUKEN	1-2	SUCTION STRAINER	DHA-06-150	TUKASA KOUEI
6				1-3	OIL LEVEL GAUGE	KLA-80A	KYOWA
7	SOLENOID V/V	DSG-01-2B2-N-60	YUKEN	1-4	PUMP SET	OIL INLET PORT	DAIKIN
8	PRESSURE SWITCH	CQ-20		1-5	OIL INLET PORT	HY-06T	DAIKIN
9	CHECK VALVE	VU-38F-38F	IL RIM	1-6	OIL COOLER	11734294-02	KAIKIN
				2	REDUCING V/V	MRP-01-B-3028	YUKEN



4.2 Hydraulic Unit

1. Specifications

Model		EHU-M07-AE-30
Oil-tank capacity		10 L
The capacity of the pump motor		Equals 2.8 Kw
The highest operating pressure		7.0 Mpa
The discharge rate adjusting range		5-25 L/min
Weight(without hydraulic oil)		46 kg
The capacity of the oil-cooler fan motor		16/15 W(50/60 Hz)
Power source	Pump motor	200/220V, 50/60Hz
	Oil-cooler fan motor	200/220V, 50/60Hz
Alarm-outputting relay		Dc 12/24A, AC 100V(50/60Hz), max. 1A
Control stop signal		DC 24V (Rated 5mA)
Standard painting		Black

Note : Delivery Condition

1) : The pressure is preset to 4.0 Mpa when delivered.

(It is possible to change the max. Pressure)

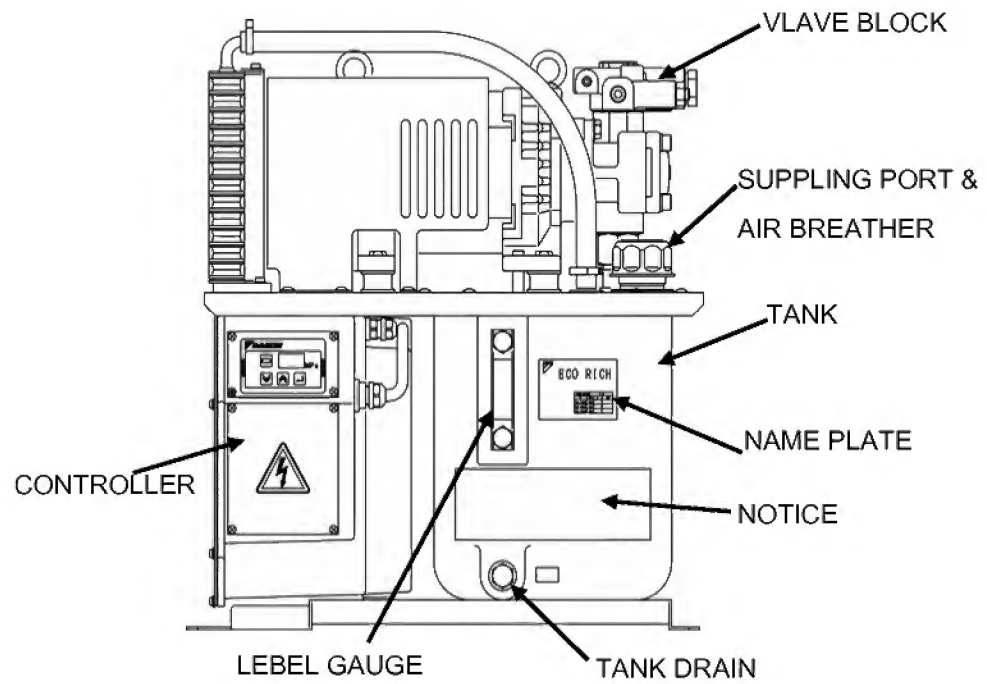
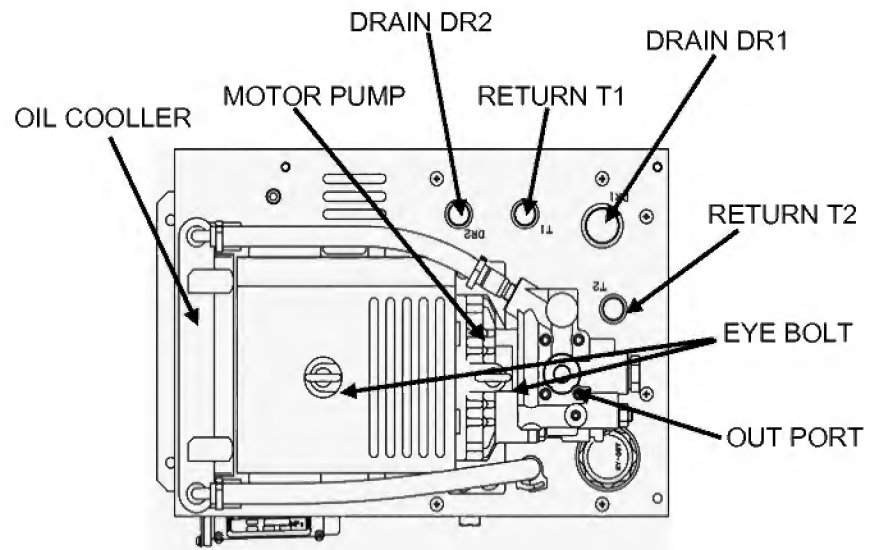
2) : The discharge rate is preset to 25l/min .

(The max. Discharge rate is a theoretical value but not an exact one.)

3) : The pressure of alarm is preset to 2.0 Mpa.

2. Working condition part

Hydraulic oil	Petroleum series of specific hydraulic oil/anti-wear hydraulic oil refer to our [general hydraulic catalog (hk196/tp)] to see the recommended brands.) • Viscosity grade : iso VG 32~68 • Viscosity range : 15~400 mm ² /s • Contamination level : within NAS class 10
Tank oil temperature	0 ~ 60 °C Recommended working temperature range : 15 ~ 50 °C
Room temperature	0 ~ 35 °C
Humidity Below	Below 85RH
Operating environment	Indoor (must be fixed by screws)
The else	•The no-fuse-breaker and an earth leakage breaker must be used. •The electric wire connecting is wired to satisfy a European standard en60204-1.
	•Do not turn on/off the power frequently, it may cause remarkable short life of the controller. Use the stop control function, in case of using operation/stop in the frequency.
	•Ground (earth) terminal must be down to ground.



3. Points for transporting, moving and installing

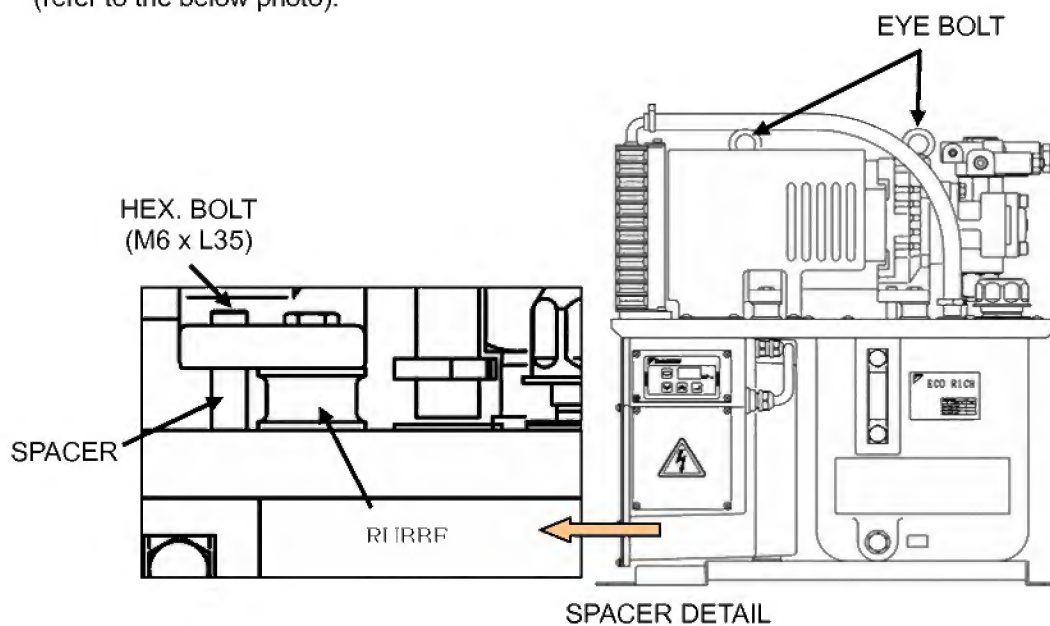
Though the vibration absorbed rubber is attached to the leg of the motor pump because of the low vibration, the low noise. It is fixed with a wing bolt (2 of M6×L35) as a transport vibration countermeasure when delivered.

- Operation

Before operation, remove the wing bolt (2 of M6×L35). If it is operated without removing the bolt, it may cause loud vibration and noise.

- Transporting

When it is being transported, install the motor base on the base tank with the wing bolt (2 of M6× L35) surely, and fix it securely to protect the vibration absorbing rubber (refer to the below photo).



Weight table (Hydraulic oil exception)

MODE	EHU14-L04	EHU25-L04	EHU25-L07	EHU25-M07	EHU30-M07
WEIGHT	43kg		45kg	46kg	

⚠ DANGER

- 1) If the vibration absorbing rubber is suspended without fixing the wing bolt for its protection, it is dangerous that the vibration absorbing rubber may break off and fall.
- 2) In case that it is suspended except for the long hole for the hook (pump piping), it is dangerous to fall and turnover.
- 3) Confirm the weight of the hydraulic unit, and suspend it within the rated load of the hanger-hook.

⚠ WARNING

- 1) Never approach during carry by hanger-hook. There is danger of the injury due to fall and turnover.

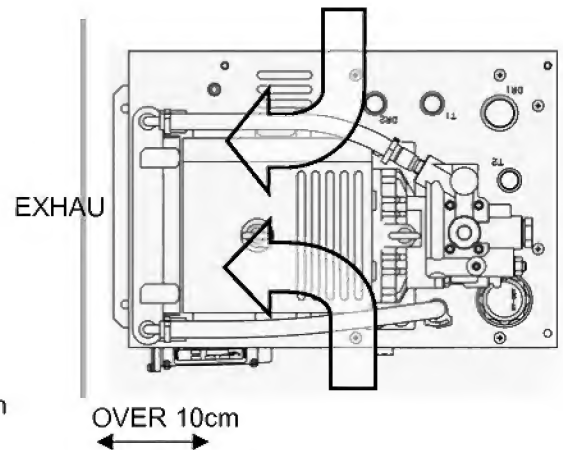
⚠ CAUTION

- 1) Do not move the tank with filling oil. (The oil leaking and air-mixing will cause inferior operation.)
- 2) During transportation, be sure to fix it so that it may not be moved by vibration and another force.

•Points for installation

◆ Securing of ventilation

Do not put the obstacle that disturbs inhalation/ exhaust of the oil cooler within 10cm from the end of the unit. Moreover, install it in the good Ventilation so that the unit may not be filled with heat, and be careful that temperature of inhalation becomes fixed surrounding temperature (less than 35°C).



⚠ WARNING

- 1) When it is used in where there is no space of inhalation/exhaust, and heat place, the heat exchange function of the oil cooler/fan motor declines, and finally, oil temperature and temperature of the hydraulic equipment becomes unusual high temperature.
- 2) In case of touching high temperature part, you may be burnt.

⚠ CAUTION

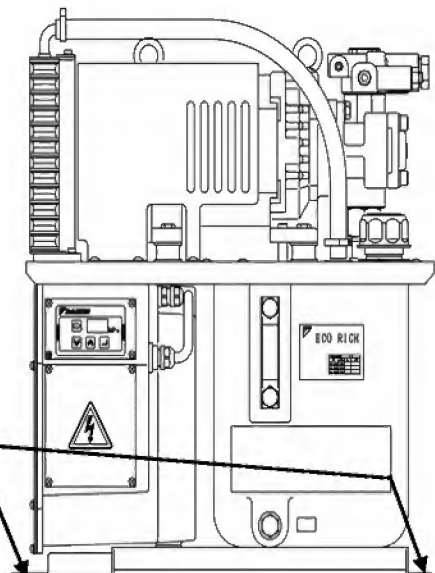
- 1) When it is used in where there is no space of inhalation/exhaust, and heat place, the motor and the controller become high temperature, and the life of the machine will be shortened apparently.
- 2) When the motor and the controller become high temperature, temperature protection suspends its operation.
(In case the motor and the controller become unusual high temperature, warning signal and alarm signal are outputted.)
- 3) If using under high temperature condition continuously, it causes troubles and shorten the life of the hydraulic equipment such as the pump and the valve as well as the above electric parts.
- 4) If using under high temperature condition continuously, it makes the quality of the hydraulic oil lower, and it's life becomes short.

◆ Installation on horizontal place

Install the hydraulic unit on the horizontal table or the horizontal floor.

Fix the hydraulic unit not to move.

UNIT FIXING HOLE Ø9 (4EA)



⚠ WARNING

- 1) If the hydraulic unit is not fixed with bolt, it is dangerous because of falling down and moving around by the hydraulic reverse-force in the pipes, so the unit must be fixed.

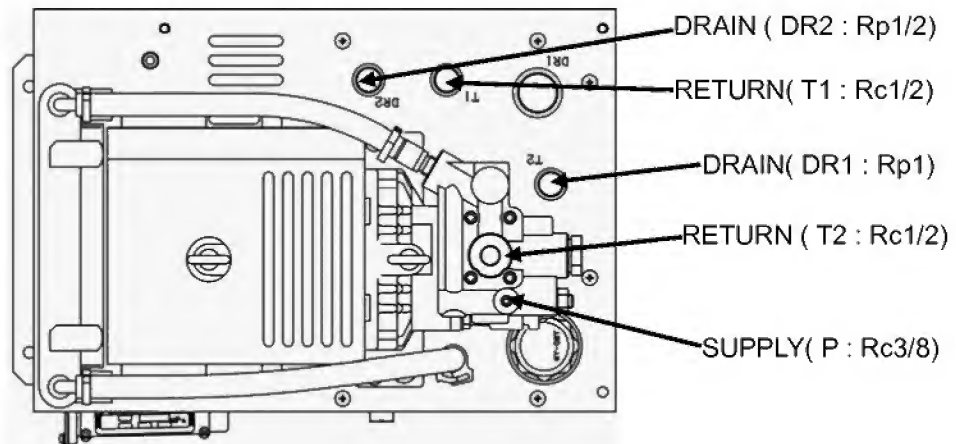
⚠ CAUTION

- 1) In case it is installed in the slope, there will be oil-leaking and air-mixing cause the unusual noise and shorten the machine life. So be sure to install it horizontally.

4. Preparation for operation

▪ Piping

Since this hydraulic unit provided with the return filter and 2 return port (in the oil) and 2 drain port (at the oil level) and 1 discharge port as well, piping according to the equipment. Each piping port has taper plug (vinyl cap) when delivered. Tighten the pipe with seal tape.

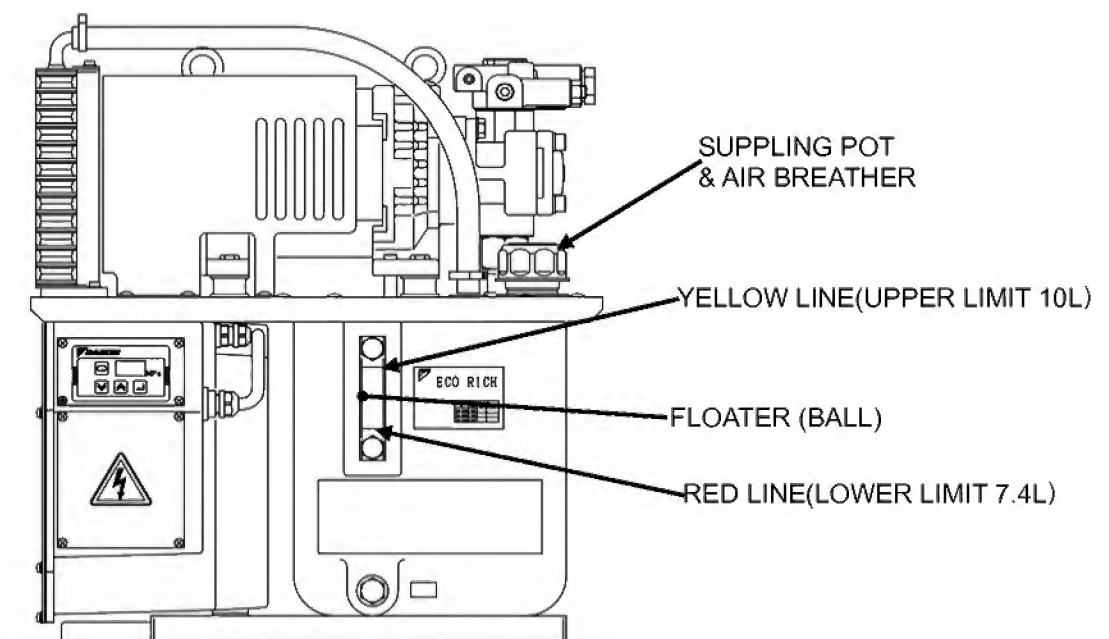


▪ Filling hydraulic oil

Remove the oil inlet port with air breather to turn counterclockwise, and put pure hydraulic oil (within NAS 10 class) in the tank.

The oil volume should be kept that the float of the oil gauge is between the red line and the yellow line.

Use the hydraulic oil appropriate to the specifications as it was mentioned in page 4-3.

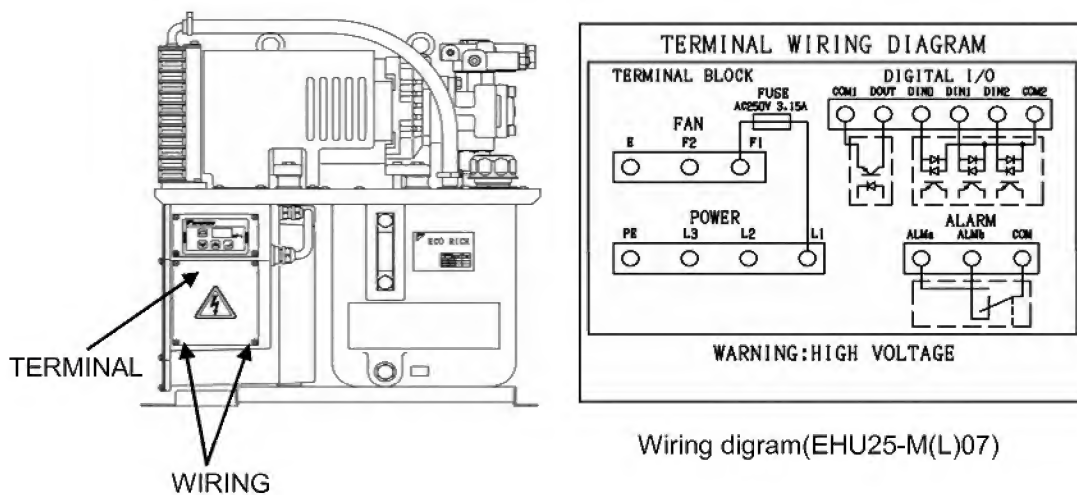


⚠ CAUTION

- 1) If it operates without putting oil in the tank, burnt and abrasion occur in the pump body, and it may be damaged.
- 2) Since oil is supplied to the hydraulic circuit on the machine at the initial operation of the machine, be careful of the oil decrease inside the tank.
- 3) The oil level inside the tank will vary a lot with the different hydraulic circuit on the machine, be careful that if the oil is overflowed from the tank or the oil level is lower than its usual level.

▪ Electric wiring

Electric wiring is on the base of the wiring diagram (the figure below) which is attached onto the back of the gap of the connecting box. Please wire correctly according to it.



⚠ DANGER

- 1) To protect the electric cycle from the over-current situations such as short-circuit, and to protect the control-part from the overload damages, the main power supply must be equipped with the air-switch and the creep aging-protector. (Please refer the order list to see the performance of the different kind of machines).
- 2) The earthing terminal must directly connect to the ground (it mustn't pass through the air-switch.)
- 3) The work of wire-connecting must be done after the installation of this machine.
- 4) The air-switch must be sure to be turned off before the wiring work.
- 5) The supply-wire must not be connected to the terminal-table that control the cycle.
- 6) Never add the extra supply-pressure which is higher than that in the specification of the product's supply.

MODEL		EHU25-M07
CURRENT	3Ø200V 50Hz	10.8A
	3Ø200V 60Hz	10.7A
	3Ø220V 60Hz	10.3A
No-FUSE-BREAKER SET UP		20A

[The nominal current-value of the inverter driving-pump]

◆The principle for wiring-connecting

- The wire-connecting of the main power supply.

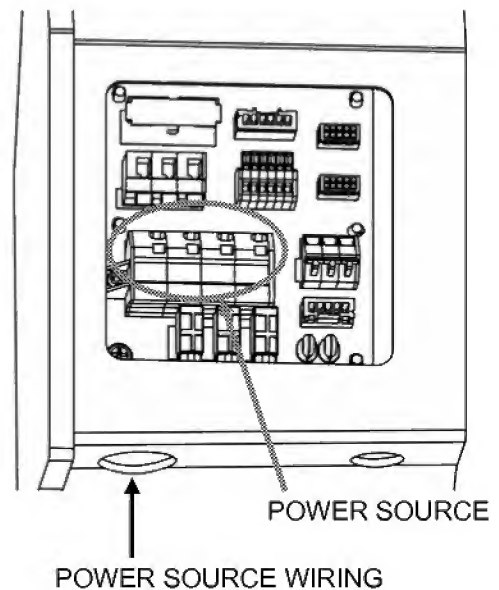
1) Remove the cross-screw(M4) from the connecting box, and opening the cover of the connecting box.

2) Making the wire pass through the wiring holes on the connecting box to do the wiring work. You should use the wire-duct that machines with the wiring-hole.

- Ⓐ The earthing-wire should be connected ground-terminal of the power supply wiring table.
- Ⓑ The wires of power supply(L1,L2,L3) should be connected to the correspond please on the wiring-terminal of the power supply wiring table.

Please follow the picture below to see how to connect with the wiring-terminal.

3) After wiring, please close the cover of the connecting box and tighten the cross screw.



⚠ DANGER

- 1) Please use the AC-supply that fits the power supply of the product.
- 2) Please use the wire AWG14(2sq.~2.5sq.)
- 3) The earthing-part of the terminal of the power supply can't be connected with the wire of power supply (L1, L2, L3).
- 4) The earthing terminal should be connected with the motor case. Please earthing by the third method.
- 5) When the wire is being peeled, please pay attention that the naked part must not be injured.

⚠ CAUTION

- 1) It takes about 10 seconds to rise up to setting pressure after in put voltage is supplied.
- 2) To avoid the mess and the corrosion of the wire-terminal, when necessary, please use the specific pressure joint terminal with the insulating-cover that is written below.

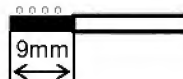
(Please refer to the sample-book from the Co.)

- 3) 2 sq. : 216-205 yellow
- 4) 2.5 sq. : 216-206 blue
- 5) Clamping tool : 206-204

• The method for connecting to terminal

- 1) Pushing by a specific screwdriver.
- 2) Conforming the length of the naked wire that should be inserted as deep as possible.
- 3) Pulling out the screwdriver.
- 4) Softly pulling the wire to be sure that if the wire is connected well.

The length of the peeled wire



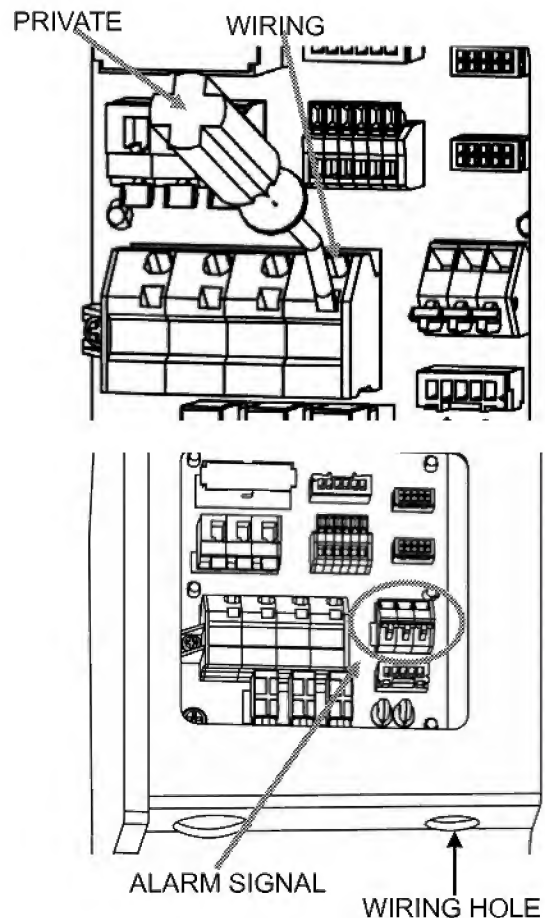
• The wire- connecting of alarming-output

- 1) Removing the cross-screw(M4 : with the packing -washer) from the connecting-box.
- 2) Making the wire pass through the wiring-holes in the connecting box to do the wiring work.
You should use the wire-duct that matches with the wiring-hole.

- 3) The wire of the alarming-device should be connected to the alarming-terminal of the supply-terminal which is affirmed by the connecting diagram attached on the cover of the connecting-box.

Please refer to the picture below to learn how to connect the wire of the alarming-device to the terminal.

- 4) After wiring, please close the cover of the connecting-box and tighten the cross-screw.



⚠ DANGER

- 1) Please use the AWG22(0.3 sq.) rubber wire with shielding.
- 2) The terminal-operation of the shielding wire must be done.
One end of the shielding must be connected to the ground.
- 3) The controlling-wire shouldn't be connected to the supply terminal.
- 4) When the wire is being peeled, please pay attention that the naked part must not be injured.
- 5) Please use DC24V or DC12V in the controlling cycle(the min. loading current : 10ma).
AC100V(50/60Hz) should be used in AC-controlling.
(It is not considered to use AC200V because of the design for pressure performance and the distance of insulating.)
- 6) The max. load -current is below 1A(resistant load).

⚠ CAUTION

- 1) ALMa is connected to COM, when alarm signal is not output.
- 2) To avoid the mess and the corrosion of the wire, when necessary, please use use the bushing with the clamp that is written below. (Please refer to the sample-book from the Co.)

AWG22 0.3 sq. : 216-322 soft green

AWG20 0.5 sq. : 216-221 white

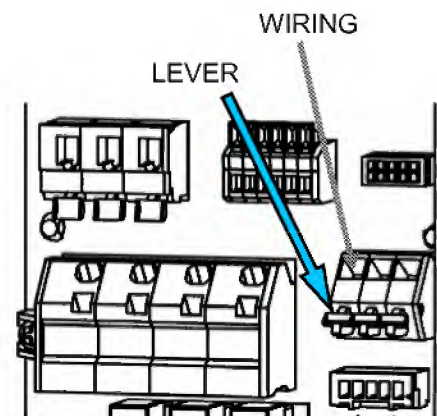
Clamping tool : 206-204

(The same as the one used for power-supply)

- The method for connecting to terminal

- 1) Opening the lock bar by a screwdriver.
- 2) Conforming the length of the naked wire
That should be inserted as deep as possible.
- 3) Reveling the power on the lock bar
- 4) Softly pulling the wire to be sure if the wire is connected well.

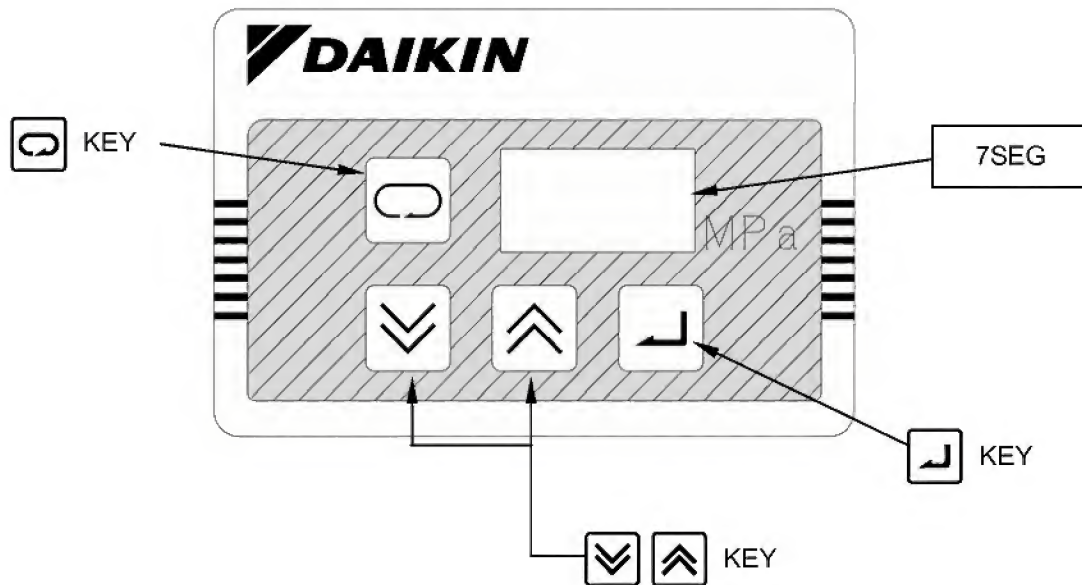
The length of the peeled wire : 6mm



5. The direction for operating the control panel

Because this hydraulic station is equipped with CPU, so it is easy to monitor and preset the pressure and the discharge rate by keyboard.

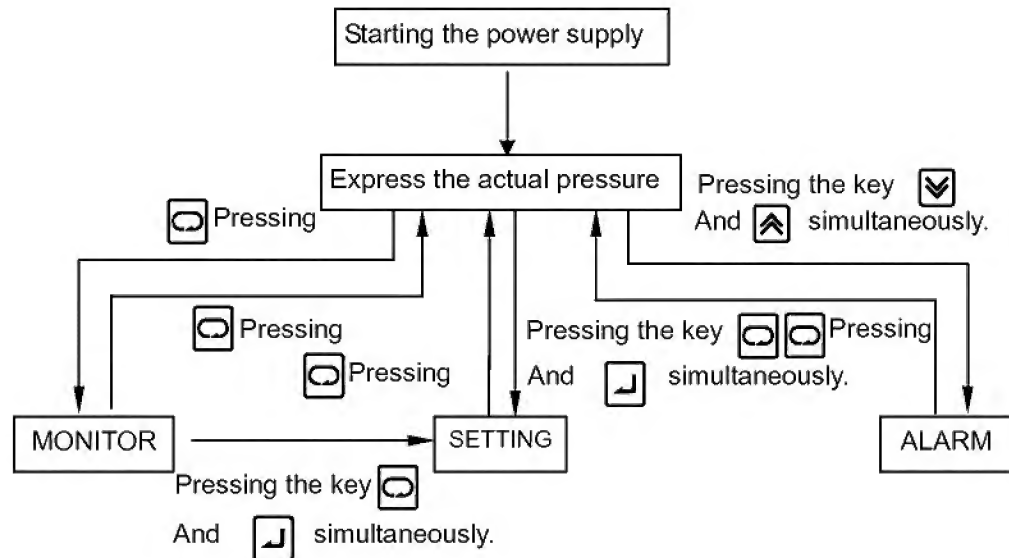
- The operating control panel is made up of the LED which has 3 column, the status key, the setting key, and the conforming key.
It's often used to express the actual pressure, and you can move between the status of monitoring and setting by operating the keyboard.



- The explanation of status
 - **NOMAL** : expressing the actual pressure and the alarming-code.
 - **MONITOR** : expressing the setting-value of the pressure-switch, the actual discharge-rate and the lasted alarming-information.
 - **SETTING** : changing the setting-value of the highest pressure and the max. discharge-rate, etc.
 - **ALARM**

▪ Changing the status

The status-changing is expressed by the picture below.



▪ Operation manual of each mode







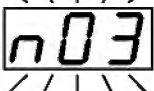
a) Monitor

You can choose to be as the table below when you are in the monitor status.

Item No.	Content.	Unit
n00	The setting-value of the pressure-relay	[MPa] or [x10PSI]
n01 ⁽¹⁾	The setting-value of the highest pressure	[MPa] or [x10PSI]
n02	The setting-value of max. discharge rate	xL/min
n03	The actual discharge rate	xL/min
n04 ⁽²⁾	The latest alarm code	* reference
n05	The location velocity	X10min ⁻¹

Refer to the operation example as below.

<Example> Monitoring actual discharge volume.

Choosing method	key-operation	LED	remark
<div>Supply-starting</div> <div>Expressing the actual pressure</div> <div>monitor</div> <div>The choice of the sequence</div> <div>When you want to Try the other monitor</div> <div>Expressing the actual Return-pressure</div>	<div>  </div> <div>   </div> <div>  </div> <div>  </div>	<div>3.4</div> <div>  </div> <div>  </div> <div>5.0</div> <div>3.4</div>	

CAUTION

1) Please refer to the expression of the alarming-items for the content of the alarming-code.

b) Setting

You can choose to set as follows in the SETTING status

Item No.	Content.	Unit
p00	The setting-value of the highest pressure	refer to specification
p01	The setting-value of max. discharge rate	refer to specification
p02	It's allowed to alarming-output when Temperature of the motor is abnormal	1
p03	The delay time of 04 alarm output	200(20mSEC)
p04	The setting-value of pressure switch, If the setting value is 0, p04 alarm is not output	2.0(Mpa)
p05~06	No function	4.5(Mpa)
P07	Standby function 1 : Control pressure rises when stand signal is not input.	1
P08	Pressure denomination(Mpa,PSI)	0(Mpa)

- This is the example of operation.

< eg. > The max. discharge rate change into 20L/min from 25L/min.

Choosing method	key-operation	LED	remark
<pre> graph TD A[Change the Setting status mode] --> B[Choosing the Sequence no.] B --> C[Expressing the Setting value] C --> D[Changing the Setting-value] D --> E[Conforming the input Of the setting-value] E --> F[Expressing the actual Return pressure] E --> C </pre>	<p>Pressing the key And simultaneously for 2 Seconds.</p>		<p>After 2 second</p> <p>The item no. Is showed by The Lighted light</p>

⚠ CAUTION

- 1) Alt can still be shown if change of the setting-value hasn't been entered to be confirmed.
But, If the Conforming key of" inputting the setting-value" hasn't been pressed and instead, the key of "expressing the actual return-pressure" is pressed, it will automatically return to the setting-value that has been set before the change.
- 2) The items that are allowed to alarming-output when the temperature of the motor is abnormal, [o] Means"no output",[1]means output.

c) The table of alarming codes

In the "ECO RICH", there are several alarming outputting performance, which are shown below.

- 1) The hydraulic station will be enforced to stop if there still be any output of alarming-signal except which shows alarming.
- 2) According to the setting under the SETTING Item p02(which allows to make alarming-output when the temperature of the motor is abnormal,) it will change into
 - The setting-value is[0] : no alarming-output
 - The setting-value is[1] : the hydraulic station will be enforced to stop in 10 minutes after the output of the alarming-expression and the alarming-signal.
- 3) According to the setting under the SETTING Item p04(which allows to make alarming-output when the pressure of the EHU is abnormal,) it will change into
 - The setting-value of p04 is 0 : no alarming-output
 - The setting-value of p04 is not 0 : alarming-output but the hydraulic station does not stop.

TYPE	ALARM CODE	CONTENT	REASON COUNTERMEASURE
1	Low-pressure of the main loop E20 Troubled-starting E80 Pressure sensor trouble E30	It will alarm if the pressure of the main loop is below 154 V. Alarming when the station can't be started. Alarming when the wiring of pressure sensor is abnormal.	Perhaps the inputting-pressure is low, or some inner wires are broken Please check the supply-wire and the supply. hydraulic Perhaps something is wrong with the pump motor. Perhaps the wire of pressure sensor is cut or the connector of pressure sensor
2	The temperator sensing-unit of the motor is abnormal The temperator of the motor rises.	Alarming when the output of the temperature sensing-unit of the motor is out of its insp ecting-range. Alarming when the temperature of the motor is over 105℃	Perhapthe temperature sensing. Perhaps the fan stops or the hole of the radiator is blocked. Please check the radiator and the fan.
3	Pressure s/w function The pressure is unusually low.	When time that pressure is lower than the setting pressure of pressure s/w longer than 30sec. Alarming	Maybe something is wrong with the pump motor, there lack of oil or the leakage is too much. Please check the oil amount and the pipes, etc

 **CAUTION**

- 1) Please over the countermeasure written above when is alarms.
- 2) If the problem still can't be solved, please contact with the maintaining branch of our company.

6. Maintaining

To long-time keep the good performance of the hydraulic station, the items below should be maintained regularly, and the troubled-parts should be repaired or be changed.

The intervals of the inspections are showed below in standard form, but they will vary with the different operating conditions and environments.

▪ Routine checks

Object/item(s)	Inspecting intervals	Inspecting Principles
<ul style="list-style-type: none"> Oil-tank -Affirming the amount of oil 	Everyday	Please make sure that the oil surface is between the red line and the yellow line of the oil-leveler, And be sure that the oil isn't mixed with air and there is no white dirt on the oil-surface.
-Affirming the temperature of oil	Everyday	Below 60℃
-Affirming the color of oil	Once/half Year	The oil-quality can be known by the oil's colour. If the oil gets to be brown, the oil should be changed.(the L4 level of ASTM : golden)
<ul style="list-style-type: none"> Oil-cooler -The rotation of the fan motor 	Everyday	<p>To make sure that if the fan motor is revolving.</p> <p>If the fan motor doesn't work:</p> <p>①The cooling-function of the oil-cooler is descending obviously. It's easy to be burnt if the temperature of the oil and machine rises, and the high-temperature will inferiorize the oil and shorten the life of the machine.</p> <p>②The motor part also became hot(the fan motor also cools the motor), and the life of the motor part is shortened as well.</p> <p>Please affirm by eyes that if the holes on the radiating flange are blocked.</p>
-The hole of the radiator is blocked	Once/half Year	If the holes are blocked, the cooling-function of the oil-cooler will descend and the temperature of the oil and machine will rise, which is easy to cause burnt. Furthermore, the high-temperature will interiorize the oil and shorten the life of the machine.
<ul style="list-style-type: none"> Pressure expression -Affirming the action 	Everyday	To confirm that if the pressure changes with the different load-condition.
-Affirming the indicating pressure	Everyday	To acknowledge the showing-value of the pressure in D,H.
• Sound	Everyday	If there exists unusual noise.
• Electric wiring	Once/half Year	<p>①Whether there is any breaks or cracks on the surface of the wires.</p> <p>②To check the earthing situation of the earthing-wire and the insulating resistance.</p>
• Rubber tube	Once/year	Whether there are breaks, cracks or injures.

Object/Item(s)	Operating intervals	Operating principles
<ul style="list-style-type: none"> Oil-tank Oil-changing 	Once/year	Change the hydraulic fluid every 2,000 hour of operation. It's harmful to the action and the life of the hydraulic machine if it is being used without changing the oil after a long-time of being laid aside.
<ul style="list-style-type: none"> Oil-cooler Cleaning the radiating Flange 	Once/year	To do the resolved-cleaning according the maintaining principles on page 23
<ul style="list-style-type: none"> Air-filter Ail-filter 	Once/year	To do the resolved-cleaning according the maintaining principles on page 24
<ul style="list-style-type: none"> Suction strainer Suction strainer 	Once/year	To do the resolved-cleaning according the maintaining principles on page 25

⚠ DANGER

- 1) Don't touch the revolving part or to be to close to it.
- 2) Because it will lead to an electric shock if you touch the inner part of the control-part by hand, please strictly follow the rules below to avoid being struck by electric current.
 - Ⓐ Please turn the supply-switch to "OFF".

The plate with the words "It's forbidden to operate the supply-switch during working" should be hung on the supply-switch to avoid the misuse during the operation.

 - Ⓑ Removing the terminal box and the cover of the terminal box after 5 minutes.
 - Ⓒ If the lighted two-stage tube that is used to confirm the capacity-sparking is dark, it means the electric energy is used up.
- 3) When it works, the electric-power mustn't be offered before the control-panel has been covered with something such as a sealed-gap.

- Maintaining principles of the oil-cooler

⚠ WARNING

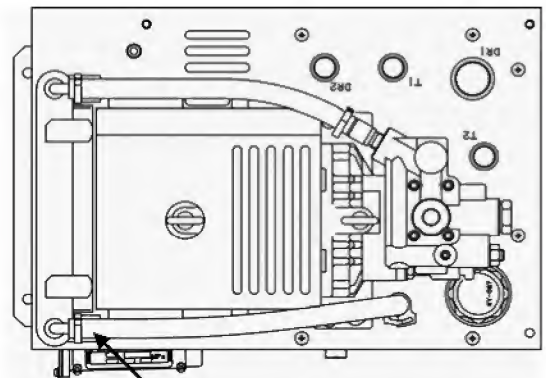
- 1) Before the maintaining, the power-supply must be unconnected to stop working.
- 2) During the operating, please put on your glasses and gloves.
- 3) Be cautious because the part is very sharp.
- 4) During the air-cleaning, be careful not to let the dirty fly into your eyes.

⚠ CAUTION

- 1) Do not pull the supply-wire and the connecting-plug of the fan motor hard during the operation.
- 2) Please pay attention that there will be oil-leakage from the pipes and the oil-cooler when dissolving.

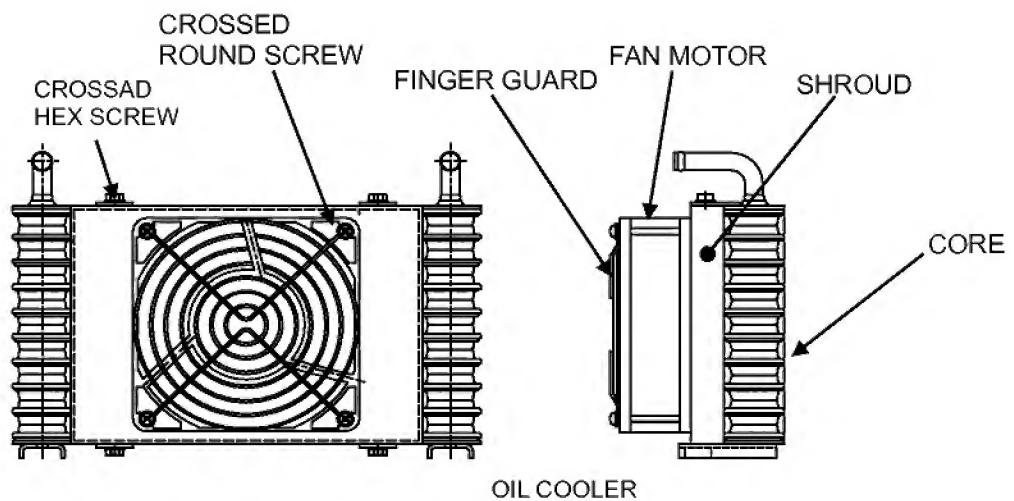
1) Removing the oil-cooler

- ① Removing the connecting-plug the motor.
- ② Relieving the 2 tube-clamps.
- ③ Remove the 2 screws of hexagon socket head of M5×L12, and replacing the oil-cooler from the up-gap of the oil-tank.



2) dissolving the oil-cooler

- ① Removing the 4 crossed hex screws of M5× L12, and desolating the radiating flange from the protectivecover.
- ② Removing the 4 crossed round screws of M4×L50, and desolating the connecting from the motor and the protective of the fan.



3) cleaning the radiating flange

At first, the radiating flange should be blown by vapour or air that can blow away the dirty that attached on the surface of the fan to make it clean. Pay attention that the dirty mustn't be come into the radiating flange.

4) Cleaning the fan motor

Cleaning the fan plane, the cover, and the gap between plane-rounding and the cover by cloth.

CAUTION

It's forbidden to blow by vapor or air.

If it is blown by vapour or air, it's easy to make the dirty come into the inner part of the motor, so, never blowing to the fan motor.

5) Reinstalling

After cleaning, please reinstall according to the original shape.

After reinstalling, operating according to the principles on page 4-8 until you're sure that it works normally. [Please pay attention not to confused the direction for air-suction/air-exhaust of the oil-cooler (page4-6).]

▪ The maintaining principles for air-filter

1) Removing method

The cover can be easily taken off if it is turned counter-clockwise by hand.

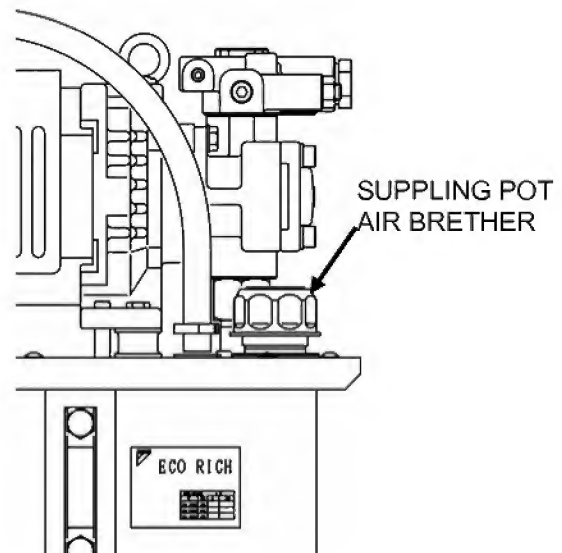
2) Cleaning method

Blowing away the unnecessary things from the filter-part by air.

The dirty in the sleeve-filter should still be cleaned.

3) The direction of installation

Cover turning the gap clockwise by hand till it can't be moved.



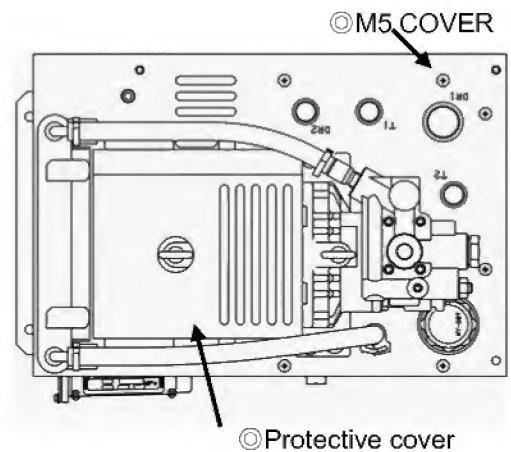
CAUTION

During the blowing by air, please put on your glasses to prevent your eyes from the dirty

▪ The maintaining principles suction strainer

1) Removing method

- ① Removing the wiring of power source and alarm.
- ② Removing six M5 screws and protective-cover.
- ③ Removing eight M5 screws jointing the upper-plate and tank.
- ④ Separate the upper-plate from the unit by raising.
- ⑤ Removing the suction strainer.



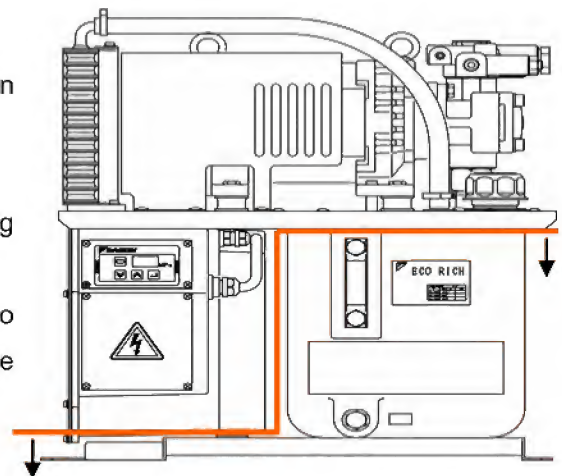
2) Cleaning method

Blowing away the dirty that attached on the surface and inside.

3) Reinstalling

After cleaning, please reinstall according to the original shapes.

After reinstalling, operating according to the principles on page 16 until you're sure that it works normally.



⚠ WARNING

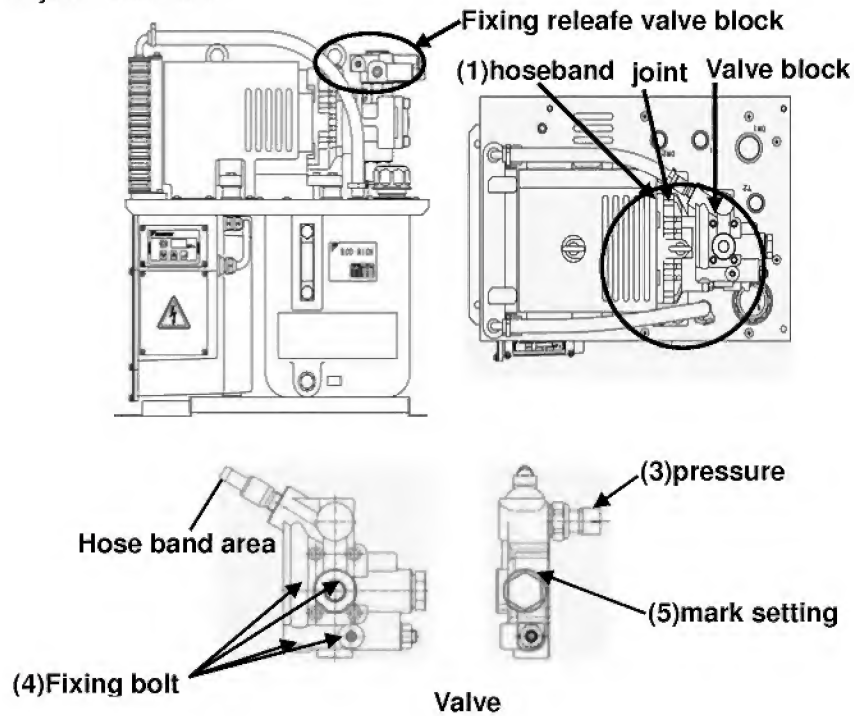
During the blowing by air, please put on your glasses to prevent your eyes from the dirty.

7. Change the PC Setting up pressure

Change the pressure of standard valve block (pressure fix relief specification)

- The case which the change does the setting up pressure of the standard valve block a next's task needs.

- ① The authentication of rotational frequency before pc setting up pressure change.
- ② Change the pc setting up pressure.
- ③ Change the valve block.
- ④ Adjust the throttle.



CAUTION

- 1) Changing the valve block Execute after the power-off.

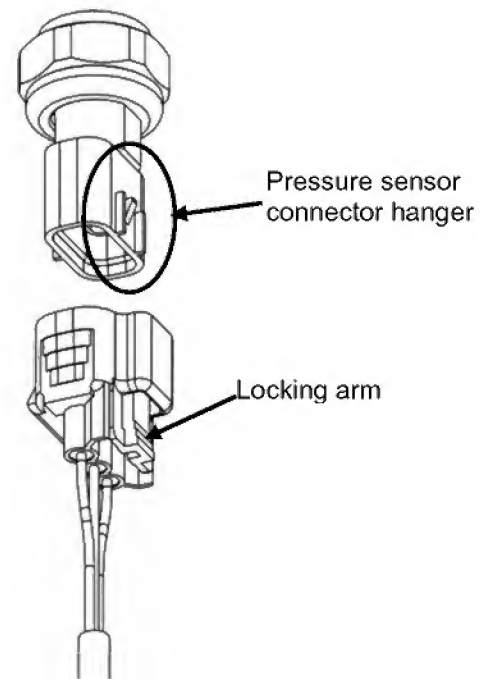
Execute in the situation which the temperature of oil goes down surely.

The worry to suffer the burn is in directly after the driving.

Do not to exude for the oil for the attention when remove the piping.

▪ The change procedure of valve block

- ① Remove the valve block.
 - 1) Remove the pipe of p-port on the valve block.
 - 2) Remove the pipe connected valve block and radiator from the joint(2), after loosen the white hose band.(1).
 - 3) Do not to exude for the oil for the attention when remove the hose band(1).
 - 4) Cover the bothside of hose and joint(2) with small vinyl packet for prevent the oil leakage.
 - 5) Remove the harness to be connected to the pressure sensor.
 - 6) Remove fore bolt to fix the valve block. Remove valve block carefully.
- ② Change the new valve block
 - 1) Check the pressure to be marked at the end of new valve block.
(ex.) When the setting pressure 1.5MPa, marking is "15"
When the setting pressure 7.0MPa, marking is "70"
 - 2) Check the two O-ring at bottom side of valve block.
 - 3) Clean the join-plane of pump and valve block.
 - 4) Raise and set the location to the pump the block. The marking point (5) look to out side of body.
 - 5) Tighten fore bolt(4) with properly torque.
Properly torque is $12.6 \pm 1.26 \text{ N/m}$ ($129 \pm 12.9 \text{ kgf/cm}$).
- ③ Restor each wire and pipe.
 - 1) Joint the harness to the pressure sensor(3).
 - 2) Clean the oil inside of hose.
 - 3) Joint the hose to the joint(2) through the hose band(1).
 - 4) Tighten the hose band(1) at suitable location of joint.






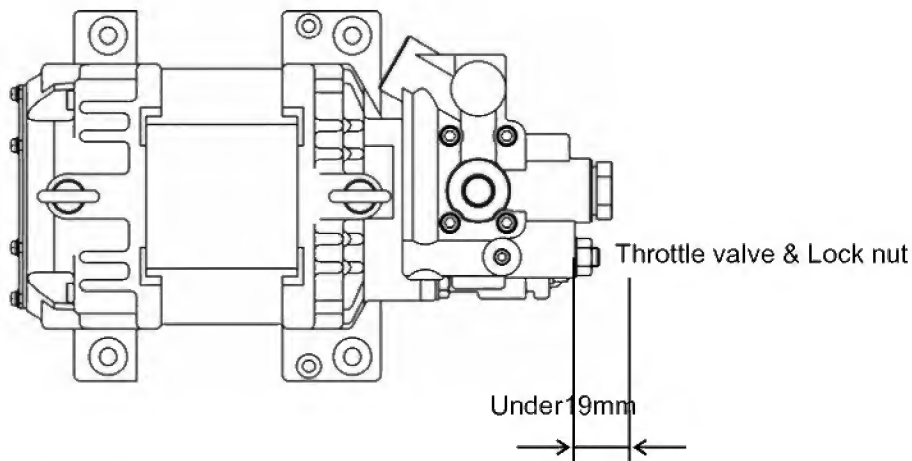
- The adjustment of minimum rotational frequency of PC

Adjust the rotational frequency after change valve block, because the rotational frequency change according to the pressure-up or pressure-down.

Min. rotational frequency : Rotational frequency before changing PC setting pressure.

(merely more than 350 rpm)

- 1) Change the expression mode to “monitor mode” to press “”.
- 2) Display actual rotation to press “setting key” at “n00” and press  at “n05”
- 3) Loosen the lock nut of the throttle valve for adjusting of minimum rotational frequency.
- 4) Adjust the throttle valve with check the actual rotational frequency.
(CW : rotational frequency down, CCW : rotational frequency up)
- 5) Tighten lock nut.
- 6) Change to the actual pressure to press “mode key” 


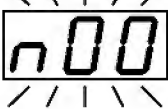




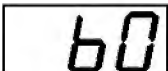
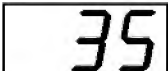

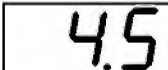


CAUTION

- 1) It become secession a lowest rotational frequency adjustment throttle valve adjustment bolt if remove too much.
Be careful not to remove over 19mm from the region with the adjustment bolt.

- This is the example of operation.

< ex. > Adjust the minimum rotational frequency to 350max

Choosing method	key-operation	LED	remark
Change monitor mode			
Change from Monitor mode	 	 n05 : rotational frequency monitor mode	
Display rotational frequency CCW Throttle v/v		 600rpm : ex (actual rpm)	× 10rpm
Set-up Adjust bolt			
Return to display Actual pressure			

- The method to change the PC pressure of variable relief v/v (type : EHU**-***-**-30V)

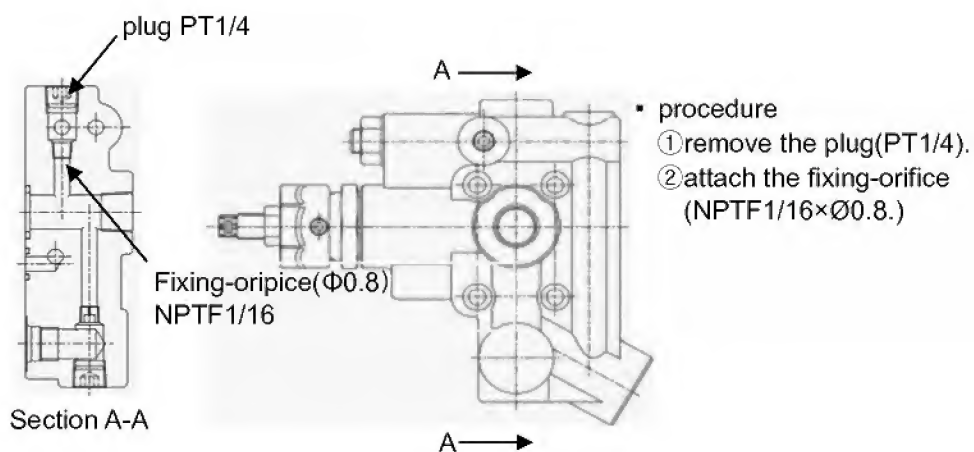
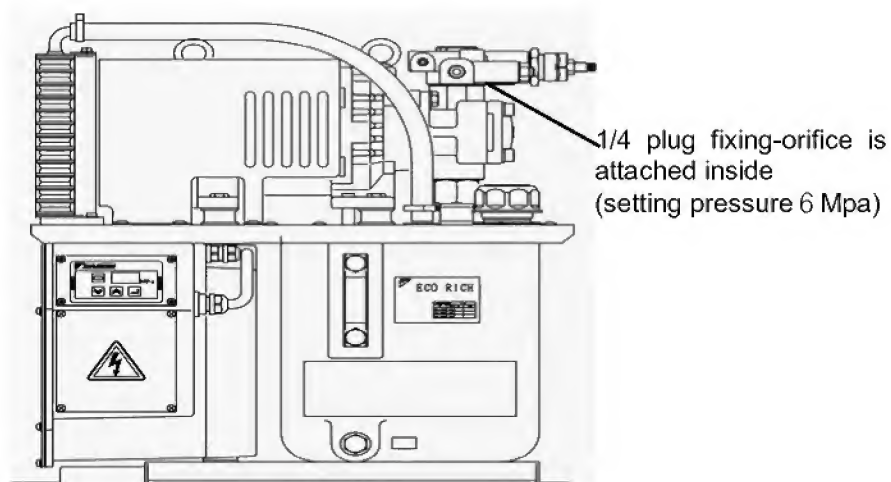
It is necessary below work to change setting pressure of V-type PC.

- ① The authentication of rotational frequency before pc setting up pressure change.
- ② The authentication of rotational frequency before pc setting up pressure change.
- ③ Adjust relief v/v
- ④ Adjust the rotational frequency by throttle v/v.

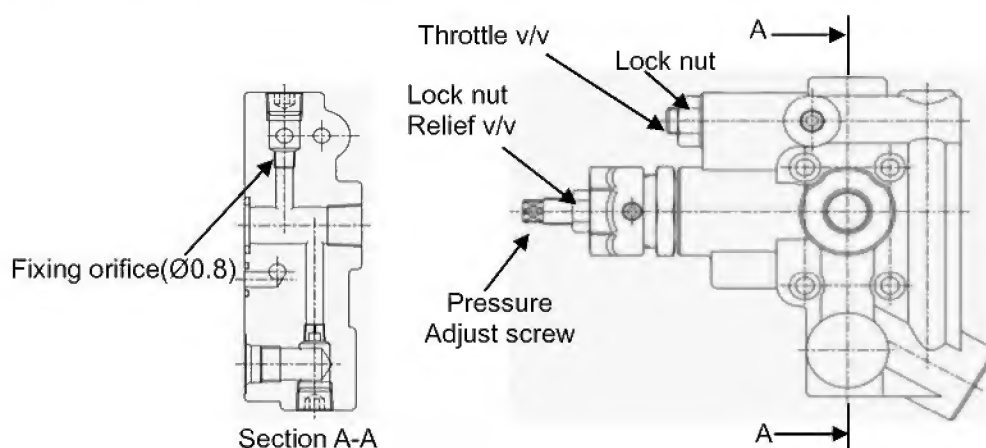
⚠ CAUTION

- 1) Install a fixing-orifice (Ø0.8) to be enclosed, when use the pc setting up pressure over the 6Mpa, and the pressure comes to be unstable to the influence of the back of oil pollution.
- 2) Confirm a fixing- orifice whether the pressure remains.

◆ The method of the attach fixing- orifice (Ø0.8)



▪ PC pressure setting-up change sequence



- 1) The pressure of the valve setting up to the maximum, after keep a pressure fort in the pressure circuit and turn ON the power supply.

Remove the lock nut of relief v/v and tighten pressure adjustment bolt of a relief valve to the utmost.

⚠ DANGER

Tighten the pressure adjust screw certainly after turn on power supply.








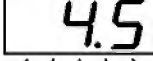



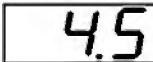
It is dangerous by the serge pressure if turn on the power supply after tighten the pressure adjust screw.

- 2) Change the PC setting pressure at the operation panel.

It is possible in the 1.5 ~ 7.0 Mpa. to adjust the pressure(EHU25-M07)

- This is the example of operation.

< ex. > Change the PC setting pressure into 4.5Mpa from 1.5Mpa

Choosing method	key-operation	LED	remark
Change to Setting mode	  Pressing the key And simultaneously	 P00 : P C pressure Setting mode	After 2second
Display setting value			
Adjust setting value	 		
In-put setting value			Display Item no.
Return to Actual pressure			

NOTE) The adjustment of the set point becomes the reflection although it does not execute the input. When return to the actual pressure does not excute the input, it return to the before change setting.




- Adjust minimum rotational frequency PC

The rotational frequency rise according to the rise of the setting up pressure.

Adjust to proper rotational frequency.


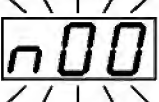


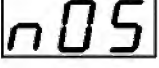




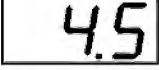
Minimum rotational frequency: Rotational frequency before change setting pressure.

(Merely more than 350 rpm)

- 1) Change to "monitor mode" to press" mode key  .
- 2) Display actual rotational frequency to press "setting-key" at "n00", and "input-key"  at "n05".
- 3) Loosen the lock nut of throttle v/v.
- 4) Adjust the throttle v/v with check the value of actual rotational frequency. (CW: down, CCW: up)
- 5) Tighten lock nut.
- 6) Change to actual pressure to press" mode key  .

- This is the example of operation.



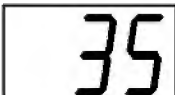
< ex. > Adjust the minimum rational frequency to 350rpm.

Choosing method	key-operation	LED	remark
Change to monitor mode			
Change from Monitor mode	 		
Display rotational frequency		n05 : rpm monitor mode	
Rotate CCW Throttle v/v			×10rpm
Set Adjust screw		60rpm : ex. (actual rpm)	
Return to Actual pressure			
			


- Adjust the pressure of relief v/v
 - 1) Check the actual rotational frequency.
 - 2) Loosen the lock nut.
 - 3) Adjust the adjusting screw with check the actual rotational frequency. (CW: down, CCW : up)
 - 4) The rpm increase suddenly at the location of the working-point of relief v/v.
And rotate the screw to the location of minimum rpm.
 - 5) Setting the adjusting screw after turning 270 degrees.
 - 6) Tighten the lock nut.

Therefore the setting pressure of relief v/v = PC setting PRESSURE + 0.5 Mpa

- This is the example of operation.
< ex. > Monitoring of actual rpm with monitor mode

Choosing method	key-operation	LED	remark
<div style="border: 1px solid black; padding: 5px; text-align: center;">Change to Monitor mode</div> <div style="text-align: center;">↓</div> <div style="border: 1px solid black; padding: 5px; text-align: center;">Change from Monitor mode</div> <div style="text-align: center;">↓</div> <div style="border: 1px solid black; padding: 5px; text-align: center;">Display rotational frequency</div>	<div style="border: 1px solid black; padding: 5px; text-align: center;">↺</div> <div style="border: 1px solid black; padding: 5px; text-align: center;">↗ ↘</div> <div style="border: 1px solid black; padding: 5px; text-align: center;">↙</div>	<div style="text-align: center;">  </div> <div style="text-align: center;">  <p>n05 : rpm monitor mode</p> </div> <div style="text-align: center;">  </div>	<div style="text-align: center;">×10rpm</div>

< ex. > when adjust the relief v/v to 5.0Mpa with monitoring actual rpm.

Choosing method	key-operation	LED	remark
<div>Display rpm.</div> <div>Start CCW adjusting screw</div>		35	
<div>Continue CCW adjusting screw</div>		35	
<div>Relief v/v working. the rpm increase suddenly</div> <div>Few CW the adjusting screw</div>		50	
<div>Adjusting screw CW 270 degrees</div>		35	×10rpm
<div>Setting the adjusting screw</div>		35	
<div>Return to the Actual pressure</div>		<div>35</div> <div>4.5</div>	

It becomes completion the adjustment with this.

(The pressure is preset to 5.5 Mpa when delivered.)

- ◆ The method of the setting of PC pressure (when recharge the pressure after change delivery pressure)

Increase the PC setting pressure : It is same that the method of the adjusting pressure of the relief v/v.

Decrease the PC setting pressure: The rotational frequency goes down if it comes down the pressure.

The pressure is unstable a lowest rotational frequency rather go down suitable rotational frequency.

Do according to the method of the adjusting pressure of the relief v/v., after increase the rpm to 600rpm refer lowest rotational frequency adjustment method.

CAUTION

- 1) Adjust in the situation without fixing-orifice, when setting the pressure under 6.0Mpa.

<Pressure conversion table>

kgf/cm²	MPa	bar	lbs/in²
5	0.49	4.9	71
10	0.98	9.85	142
15	1.47	14.7	213
20	1.96	19.6	284
25	2.45	24.5	355
30	2.94	29.4	426
35	3.43	34.3	497
40	3.93	39.3	568
45	4.41	44.1	639
50	4.90	49.0	710
55	5.39	53.9	781
60	5.88	58.8	852
65	6.37	63.7	923
70	6.86	68.6	994
75	7.35	73.5	1065
80	7.84	78.4	1136
85	8.33	83.3	1207
90	8.82	88.2	1278
95	9.31	93.1	1349
100	9.80	98.0	1420

4.3 Breakdown and countermeasures

When there is a trouble with hydraulic unit, refer to the following.

1. When cylinder works irregularly or doesn't work

- 1) It is considered that air mixed into hydraulic pipe. If the joint part of pipe is loosened, remove air, and then fasten the loose part. After confirming the oil gauge of hydraulic tank, replenish oil if oil is insufficient.
 - 2) There is a possibility that friction resistance of operating part has been increased. After confirming the hardening of seals of cylinder and piston, if they are inferior, replace them with new ones. If the lubrication status of operating side is bad, supply oil.
 - 3) It is considered that internal oil leakage has been increased. Check the oil leakage for cylinder and valves. If O-ring has been worn, replace it.
 - 4) It is considered that external oil leakage has been increased. Check the oil leakage for pump, valve and pipe.
 - 5) It is considered that the operation of solenoid valve is abnormal. Confirm electric circuit, and confirm that the alteration range of voltmeter is within DC 24±5%.
- Confirm that the surrounding temperature is less than 35°C. Confirm oil.
 - Confirm that the viscosity is within the range of 20cSt~88cSt.
 - Confirm that the oil temperature is less than 65°C.

2. When noise occurs

- 1) Pump suction is bad
 - Confirm oil temperature and if it is low, raise the temperature.
 - Use the oil keeping its temperature at the range of 5°C~65°C.
 - Clean the section filter.
- 2) Pump parts are damaged and worn
 - Replace pump and oil.

3. When hydraulic motor is overheated

- 1) There may be the breakdown of hydraulic motor.
 - Confirm it separating pump and motor.

4. When oil is overheated

- 1) Confirm the viscosity of oil.
 - The viscosity should be within the range of 20cSt~88cSt.
- 2) Confirm the amount of oil in the tank, and if it's insufficient, replenish oil.
- 3) Surrounding temperature should be within the range of 5°C~35°C.

5. When solenoid is overheated

- 1) If there are foreign substances in the spool, disassembling and cleaning are required.
- 2) Confirm the electric power source.
- 3) Confirm the oil temperature in hydraulic tank.
- 4) Confirm that the bolt fixing solenoid valve are loose

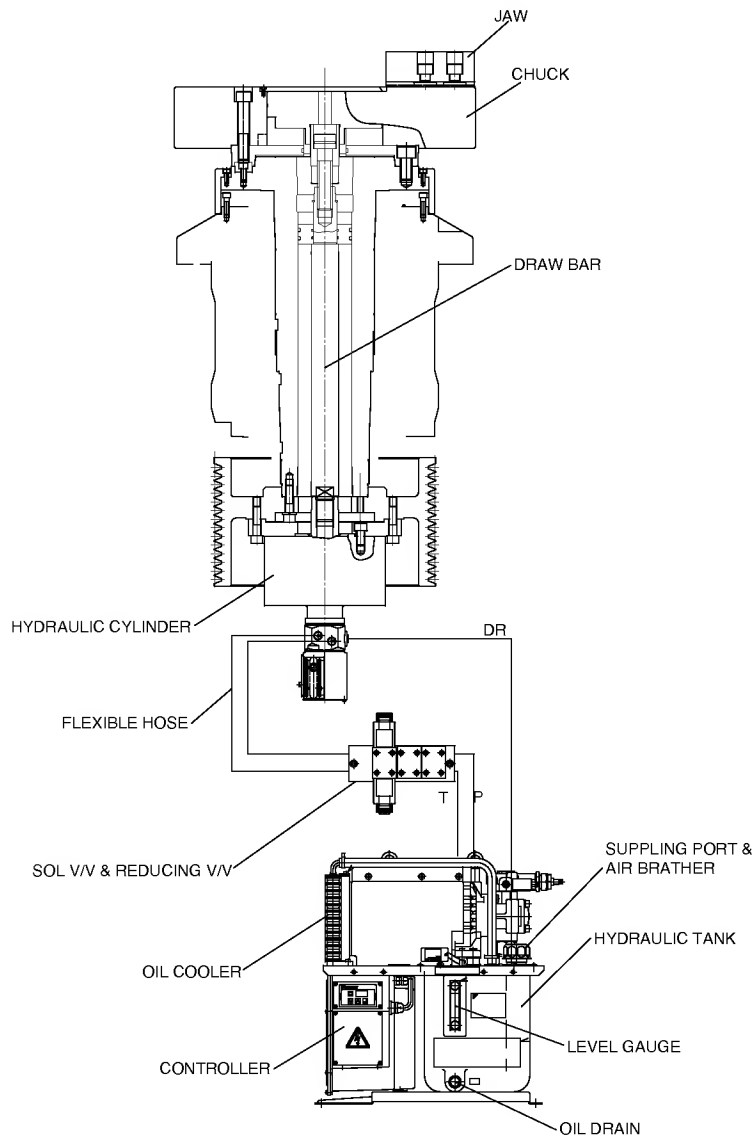
5. Hydraulic chuck and cylinder system

Hydraulic chuck and cylinder system is made up of the following parts.

- 1) Hydraulic unit
- 2) Solenoid valve
- 3) Hydraulic cylinder
- 4) Draw bar
- 5) Hydraulic chuck
- 6) Other attaching parts

Chuck is installed in the surface of spindle, and hydraulic cylinder is installed in the rear of spindle. Chuck and cylinder is connected with draw bar.

<Outline>



5.1 operation of hydraulic chuck

- 1) Hydraulic chuck is opened and closed by the foot switches.

Gripping force can be adjusted by varying the hydraulic pressure with the reducing valve.

Allowable pressure and gripping force depend on the type of chucks.

Therefore, when adjusting the gripping force, refer to the instruction manual for each chuck

Range of pressure adjustment 6 ~ 50 kgf/cm² (58.9 ~ 490 N/cm², 85 ~ 708 lbs/in²)

Knob of reducing valve CW (clockwise) ⇒ rotation for pressure increase

CCW(counterclockwise) ⇒ rotation for pressure decrease

⚠ WARNING

Chucking force decreases as the spindle speed increases. When the spindle speed is 2000 rpm and 3-jaw/15-inch serrated type is used, the chucking force is reduced to two-third of the rated chucking force.

- 2) Open/close of hydraulic chuck is available only when the spindle is stopped.

⚠ DANGER

- 1) While the hydraulic chuck is opened, spindle rotation is not available regardless of the selected operation mode. Note that inching operation is available at this time.
- 2) Incomplete chucking of a workpiece is dangerous. Workpiece chucking status should always be checked before starting the spindle.

- 3) Chucking direction selector key switch

Chucking direction can be easily changed by the chuck direction key switch mounted on the operation panel.

- 4) Hydraulic chuck automatic open/close commands.

M 14 ⇒ Close

M 15 ⇒ Open

5) Hydraulic chuck open/close confirmation switch (option)

This machine has an option to confirm the chuck open/close status using limit switches, thus assuring safe operation. If your machine is equipped with this function, it is necessary to adjust the chuck open / close confirmation switches properly when workpiece is changed. These switches are mounted at the machine rear and can be accessed by removing the back cover.

<RIGHT>

<LEFT>

BS511 ⇒ Confirmation of hydraulic chuck close

⇒ BS541

BS512 ⇒ Confirmation of hydraulic chuck open

⇒ BS542

6) Recommended hydraulic chucks

The following hydraulic chucks are recommended for this machine. (Made by SAMCHULLY)

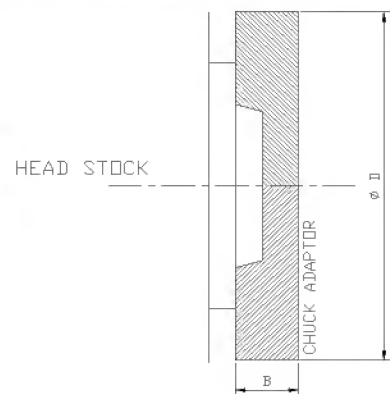
Item	3 Jaw Solid	
	24 inch	32 inch
Type of chuck	HC-24	HC-32
Type of cylinder	Y2050RE (SAMCHULLY)	Y2050RE (SAMCHULLY)
Max. speed (r/min)	1,760	1,760
Max. pressure(bar)	28	40
Chucking power(KN)	273	273
Jaw stroke(Dia, mm)	16	15
Max. gripping dia (mm)	610	800
Min. gripping dia (mm)	152	200

7) CHUCK ADATER

- When attaching chucks (other than standard parts) and special jigs, you must use the chuck adaptor with the following measur

Chuck adapter OD dimension

MODEL	D (Minimum)	B (Minimum)
VT900	Φ 380 mm	42 mm



- If the diameter of the chuck adaptor is smaller than the specified dimension, coolant might seep into the headstock and mix with the lubricating oil.
- Thickness(B) of the chuck adaptor should be determined to the chuck and fixture specifications.
- If a special fixture or chuck is directly mounted to the spindle, consider the design so that the OD dimension (OD) may be secured.

▲ WARNING

- 1) For combinations other than those listed above, consult our service representative.
- 2) The maximum speed listed above is for the chucks themselves and does not correspond to the maximum speed of the machine.
- 3) For items not listed in the table, refer to the operation manuals for the chucks.
- 4) Confirm that the chuck body, jaw, and stopper are securely fixed before operation.
- 5) Close the door to rotate the spindle.
- 6) For safety, never rotate the spindle at a speed exceeding the allowable speed.
Particularly when using the constant surface speed control (G96), carefully execute a spindle maximum speed setting (G50) to prevent the spindle speed from exceeding the allowable speed.
- 7) Carefully check the chucking power of the hydraulic chuck, which decreases as the spindle speed goes up. Also check the cutting condition to prevent workpiece from flying away.
- 8) The design and specifications of this machine may be changed without prior notice due to constant machine improvements.
- 9) Chuck air blower (option) Chips accumulating on the chuck can be blown off by compressed air.

5.2 Specification

1. Gripping force

Gripping force depends on the status of supplied oil, the grease used or the height of jaw. To get the gripping force stated in the chuck operation manual, the using terms are applied.

- 1) The standard soft jaw should be used.
- 2) As supplying oil, the grease to which the bi-emulsified molybdenum is added should be used.
- 3) Attaching bolts of jaw should be mounted with the specified torque.
Cylinder thrust is the maximum allowable thrust

<The attaching bolt torque>

M 6	130 kgf•cm
M 8	390 kgf•cm
M 10	740 kgf•cm
M 12	1,090 kgf•cm
M 14	1,740 kgf•cm
M 16	2,550 kgf•cm
M 20	4,100 kgf•cm

2. Maximum allowable speed

The maximum allowable speed is indicated as the actual value when the gripping force during rotation becomes about 1/3 of the gripping force during stop.

< Terms >

- 1) The standard soft jaw should be used.
- 2) The position of master jaw should be at the center of stroke.
- 3) Jaw should be uniformly attached on the circumference of chuck.

CAUTION

Between the maximum allowable rotation speed of chuck and cylinder, if one side speed is lower, adjust it to the lower speed.

3. Relation between gripping force and rotation speed

As the rotation speed increases, centrifugal force of jaw comes by and chuck is lowered. The curve line at "Gripping Force & Rotation speed Relation Diagram" has been drawn based on the gripping force in which the standard soft jaw was used.

CAUTION

If heavy cutting is executed for long time at high spindle speed, works may slip or fly away. Enough caution is required.

Example) SAMCHULY Solid chuck(HC-24)

<Gripping Force Performance Curve>



5.3 Mounting the chuck

- 1) Mount a draw pipe to the cylinder



When screwing the draw pipe into the cylinder piston rod, the piston rod should be extracted. If it is mounted at the middle position, the piston retaining pin will be damaged

- 2) Mount the cylinder adapter at the rear of the spindle pulley.
- 3) Mount the cylinder to the cylinder adapter
- 4) Check the run-out of the cylinder's outside diameter (below 0.01)
- 5) After making sure that all the steps above are completed, connect the hydraulic hoses.

Turn on the power

OBSERVANCE

Operate the cylinder several times at a low pressure (4 to 5 kgf/cm²) and stop the piston rod at the advance end.

- 6) Remove the soft top jaw and cover from the chuck and insert the connecting handle into the chuck center hole. Fix chuck to the draw pipe while turning the draw nut.
- 7) Mount the chuck to the spindle nose and tighten the chuck mounting bolts
Uniformly tighten the bolts at the specified torque. If the bolts are not tightened uniformly, the chuck will run-out
- 8) Adjust the wedge plunger position. The wedge plunger should be positioned so that the clearance between the wedge plunger, at the advance end, and the chuck body is 0.5 to 1 mm. The master jaw is in the open position
- 9) Mount the cover
- 10) Check run-out of the chuck. Run-out of the chuck (on periphery and on surface) should be within 0.02 mm. The master jaw is in the open position
- 11) Open and close the chuck to make sure that the chuck operates correctly and the jaws move smoothly.
- 12) Increase hydraulic pressure to the allowable cylinder thrust pressure.
- 13) Make sure that there is no oil leaking or other abnormalities
- 14) Rotate the spindle in the forward direction at 100rpm to check chuck vibration
- 15) Gradually increase the spindle speed to the limit (allowable chuck or cylinder speed)
- 16) Check vibration. If the vibration is excessive stop the spindle. Adjust run-out of the cylinder adapter, cylinder, chuck, and draw pipe.

5.4 Adjusting the cylinder operation check proximity switch (Option)

A workpiece clamp/unclamp detection proximity switch is mounted on the coolant collector or rear part of hydraulic cylinder. Cylinder operation is checked by this proximity switch

<Mount>

Adjust the proximity switch position by sliding the adjusting plate so that the distance between the proximity switch and the detection plate edge is approximately 1 mm. The LED in the proximity switch indicates whether or not the proximity switch is operating



If coolant overflows the coolant collector, it will enter the hydraulic unit from drain port. Be very careful that chips do not accumulate in the coolant collector.

5.5 Cautions for Chucking



- 1) Chuck pressure should be set less than the lower allowable pressure either chuck or cylinder.
- 2) Chuck pressure should be set according to the shape and cutting condition of work piece.
If a pipe-shaped work piece is chucked at high pressure, it may be distorted.
- 3) Consider the chuck pressure according to the height of soft jaw. When the higher soft jaw than the standard height, reduce hydraulic pressure.
- 4) For the work piece manufactured by forging or casting, a hard jaw should be used because the chucking place is black and hard. When the chucking part is line- / dot-contacted depending on casting gradient, cemented carbide spike is recommended to be added to the jaw. When a soft jaw is used, 6 dot-contacted processing should be executed so that the work piece and the jaw can be face-contacted. The soft jaw should be made at 0.5~1mm smaller diameter than the chucking diameter with the soft jaw completely closed.
- 5) Never open and close the chuck during its rotation and separate work piece after the spindle stops.
- 6) When long work piece is processed, be sure to use tailstock or steady rest to support the free end of work piece securely.

5.6 Chuck pressure adjustment

- 1) Loosen the lock nut of chuck pressure adjusting handle.
- 2) Adjust chuck pressure by turning the chuck pressure adjusting handle looking the chuck pressure gauge.
- 3) Turn it to the left to reduce the pressure, and the right, to increase the pressure. Be careful enough for pressure set up.
- 4) Reconfirm chuck pressure with 2~3 times of open/close by foot switch.
- 5) Fasten the lock nut of chuck pressure adjusting handle.

5.7 Disassembling the chuck

1. Disassembly interval

- 1) Remove the soft top jaw.
- 2) Remove the cover form the chuck surface.
- 3) Disconnect it from the draw pipe by turning the draw nut with the connection handle.
- 4) Loosen the chuck mounting bolts and remove the chuck.
- 5) Remove the wedge plunger.
- 6) Push the master jaw inward to remove it from the back of the chuck.
- 7) Remove the plunger nut from the wedge plunger. Remove the draw nut at the same time
- 8) After the disassembly, wash the chuck parts carefully with oil or benzine and dry them.
- 9) Remove chips and the damaged and seized forms inside the chuck body, wedge plunger slideways, and master jaw slideways. Apply grease containing molybdenum disulfide

CAUTION

Low quality grease will deteriorate the gripping force and cause the chuck to seize.

- 10) Reassemble the chuck by reversing the order of disassembly

OBSERVANCE

Adjust body to the number of Master Jaw, Wedge Plunger.

5.8 Troubleshooting

WARNING

If a problem occurs with the chuck, check the following and take proper corrective action before calling your local DOOSAN SERVICE representative.

1. Chuck does not move

- 1) When chuck parts are damaged, disassemble the chuck and replace the damaged parts.
- 2) When the operating part is pressed and stuck, disassemble the chuck and clean the pressed and stuck part.
- 3) When hydraulic cylinder doesn't work, confirm the hydraulic circuit. Confirm the movement of hydraulic hose to see the hydraulic oil is available

2. Master Jaw do not move at the specified stroke

- 1) When there are alien substances in the inside of chuck, disassemble the chuck and clean it.
- 2) When the draw pipe is loose, tighten it again.

3. A Workpiece slips in chuck during cutting

- 1) If the stroke of master jaw is not proper, adjustment is required so that the master jaw can get to the center of stroke when the work piece is clamped.
- 2) Confirm the chuck when the gripping force is lowered.
- 3) When the diameters of work piece and soft Jaw are different, reprocess the soft jaw.
- 4) When cutting force is strong, calculate the cutting force and change the cutting condition.
- 5) When the rotation speed is high, lower the speed until the required gripping force is obtained.
- 6) Confirm whether the viscosity of oil conforms to the specified value. When the viscosity is low, exchange the oil.

4. A workpiece is not finished to required accuracy

- 1) When the chuck outside is rocking, confirm it and reassemble the chuck.
- 2) If there are alien substances or chips in the serration part of master jaw and soft jaw, separate the top jaw and clean the serration part.
- 3) When the attaching bolt of top jaw is not properly locked, tighten it with the specified torque.
- 4) When the processed status of top jaw is bad, confirm the processing block and the illumination of processing part of chuck pressure while processing, and reconfirm the top jaw.
- 5) When the top jaw is transformed or the bolts are expanded because the height of top jaw gets higher, adjust the height as low as possible.
- 6) When workpiece is transformed due to the strong gripping force, lower the force to the range that processing can be done.

5.9 Oiling

1. Daily oiling

To maintain high accuracy of the chuck for a prolonged period, it is necessary to supply lubricating oil. Improper lubrication will cause the following problems

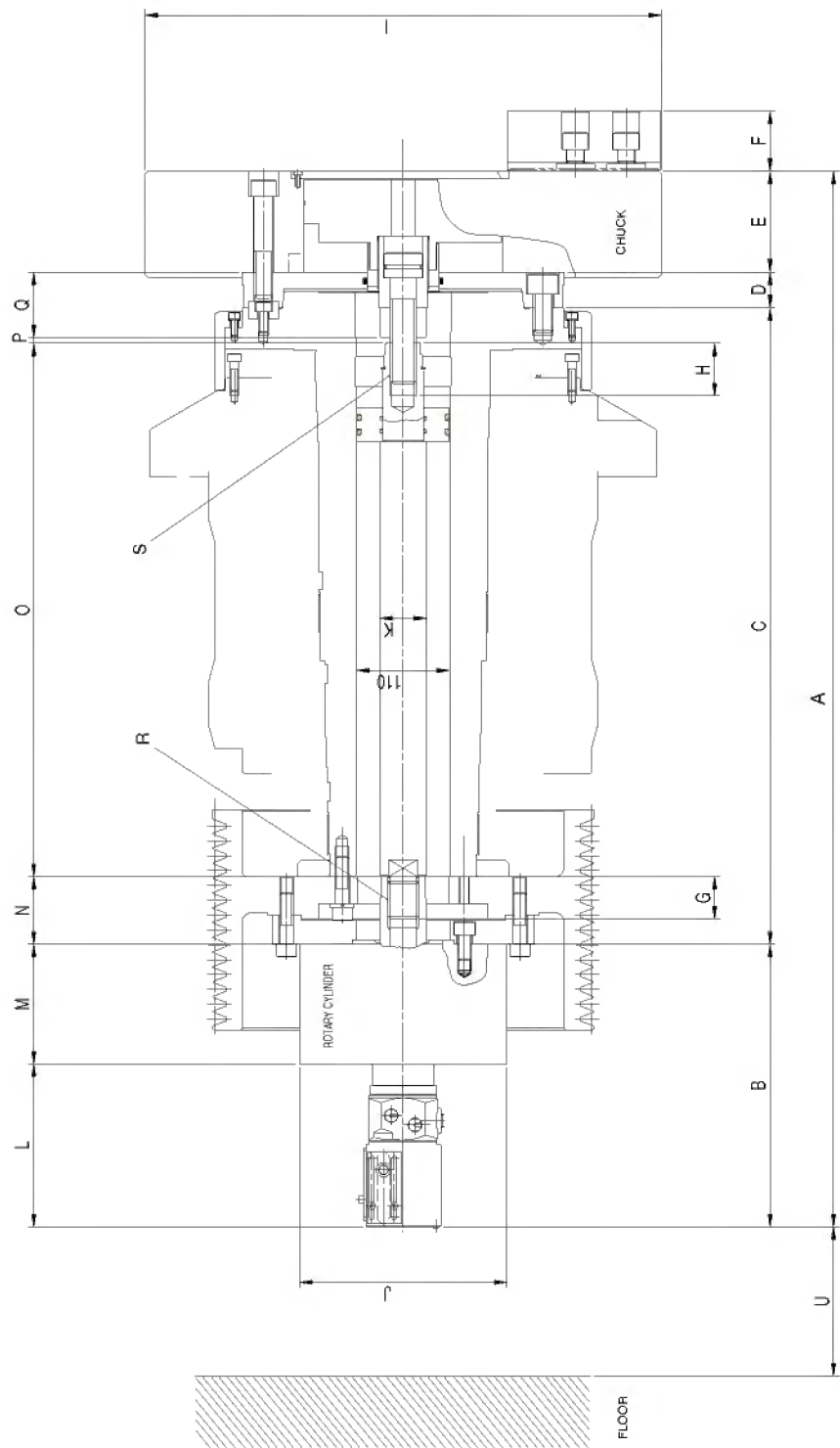
- 1) Faulty operation at low hydraulic pressure.
- 2) Insufficient gripping force.
- 3) Low gripping accuracy.
- 4) Abnormal wear.
- 5) Seizure.

Therefore, always supply lubricating oil every day.

2. Daily cleaning

At the end of each day when operation is completed, clean the chuck body and slideways.

5.10 Hydraulic Chuck and Cylinder



MODEL	SPINDLE DRIVE	ROTARY CYLINDER	SPINDLE NOSE	Draw Bar	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	QD MAX/MIN	R	S	U
PUMA VT900 Series	α 40	Y2050RE	A2-15	LVWC005	1245	333	751	42	119	71	50	62	610	245	55	192	141	80	629	7	112/77	M36x4.0	M30x3.5	176
		Y2050RE	A2-15	LVWC006	1270	333	751	42	144	83	50	75	800	245	56	192	141	80	709	7	35/-3	M36x4.0	M30x3.5	176

6. Air pressure system

6.1 General

Air pressure system consists of air filter, regulator, solenoid valve and piping parts.

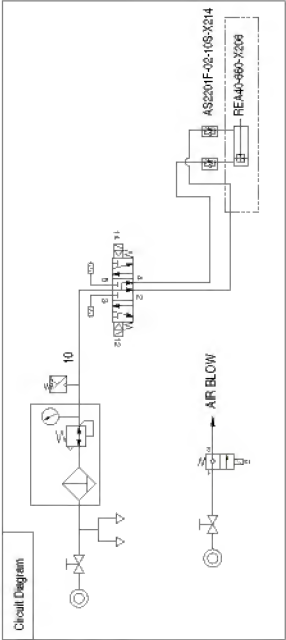
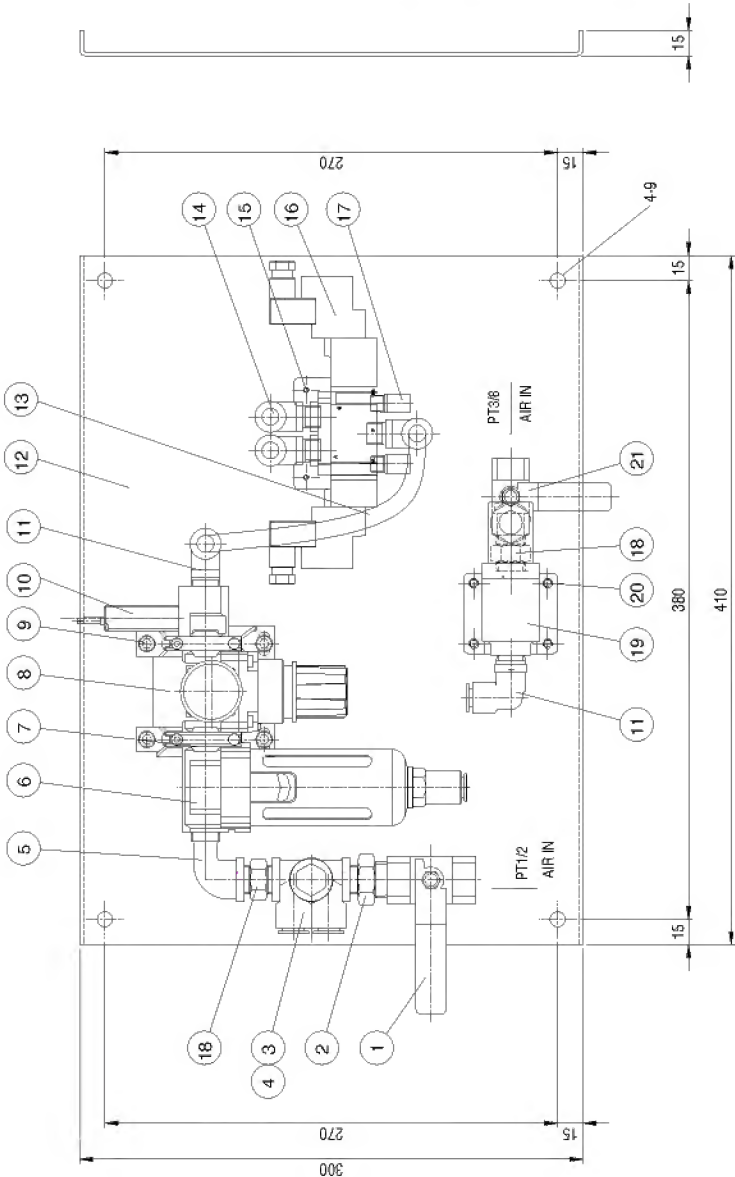
- 1) The compressed air supplied through the air supplying hole becomes clean and dry air after the moisture or alien substance in the compressed air is filtered with the air filter.
- 2) And then, the pressure of compressed air is regulated by the regulator conforming to the air instrument.
- 3) The compressed air regulated is transmitted to the solenoid valve, controlled it's path and operates each air instrument

6.2 Parts to use compressed air

The parts operated by compressed air are as the following.

- 1) Air blow for cleaning chips on the chuck and work piece (opt.).
- 2) Cylinder for automatic door open and close(opt.).

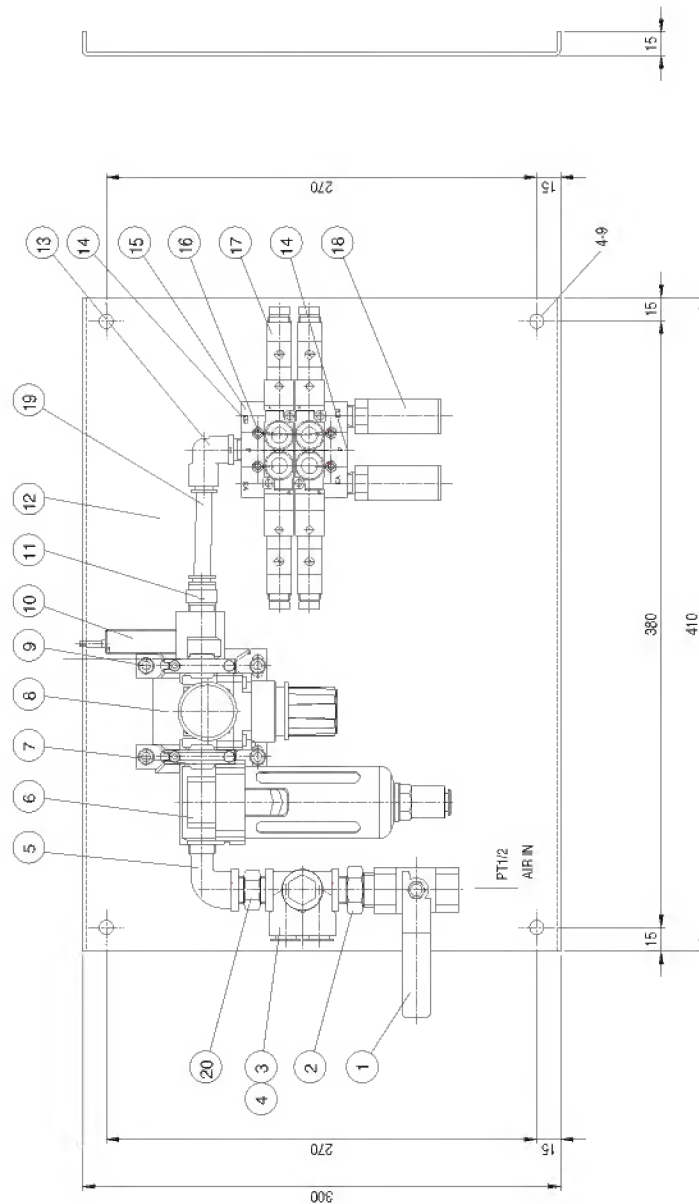
(2) AUTO DOOR & AIR BLAST



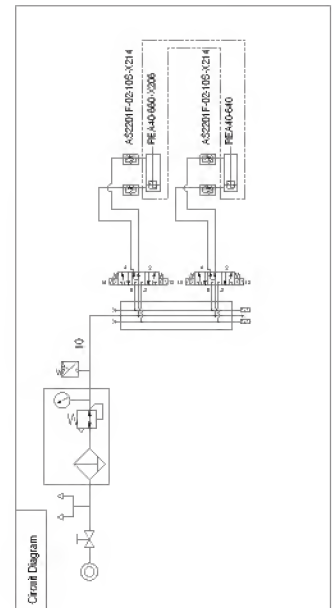
No.	PART No.	PART NAME	QTY	REMARK
22	AS220F-02-10S-X214	SPEED CON'	2	
21	PT38BV	BALL VALVE	1	
20	WM6X0.8X10L	WRENCH BOLT	4	
19	VC431-5DL-4-03-F	SOL. VALVE	1	
18	PT38N	NIPPLE	2	
17	AM103-01	SILENCER	2	
16	SY7520-5DZ-09F2	SOL. VALVE	1	
15	WM6X0.5X10L	WRENCH BOLT	2	
14	KQ2L10-02S	FITTING	3	
13	TU1065BU	TUBE	0.1m	
12	AF30-42LZ1884	PANEL	1	
11	KQ2L10-03S	FITTING	2	
10	IS100VE-0003	PRESSURE SWITCH	1	
9	WM6X1.0X15L-N	WRENCH BOLT	4	
8	AF30-03G	REGULATOR	1	
7	Y300T	SPACER	2	
6	AF30-03D	FILTER	1	
5	PT38EF	ELBOW	1	
4	KQ2212-03S	FITTING	1	
3	PT38T	TEE	1	
2	PT12-38DN	NIPPLE	1	
1	PT12BV	BALL VALVE	1	

2. PUMA VT900

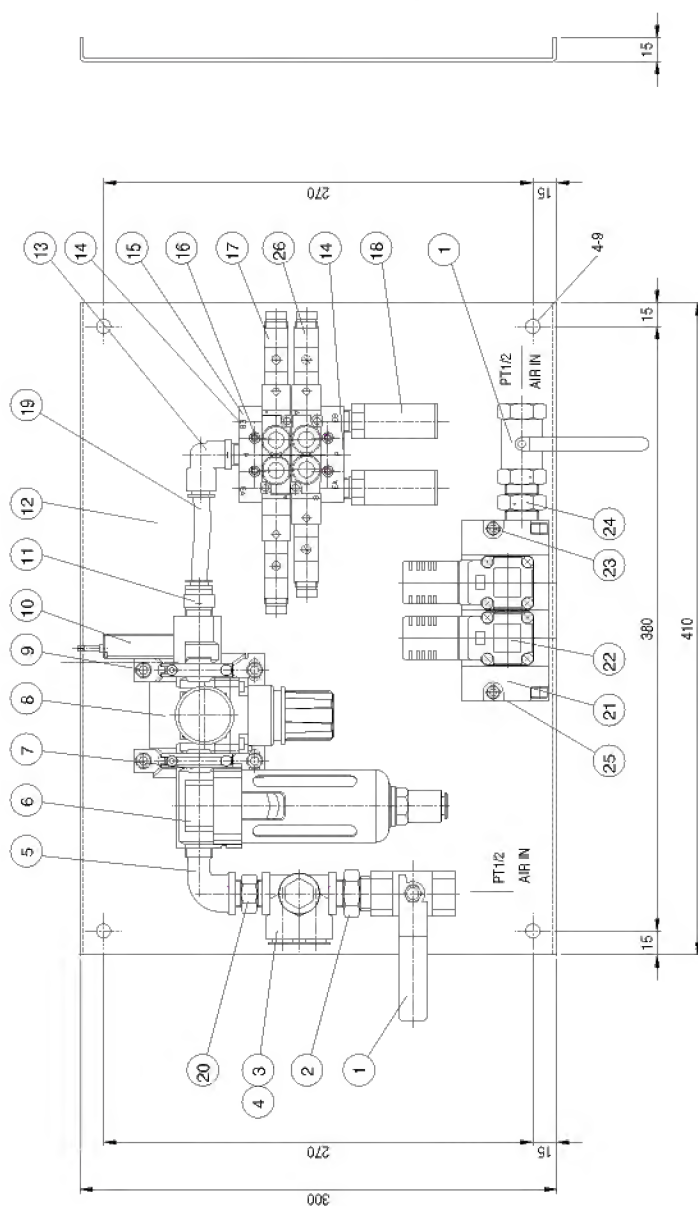
(1) FRONT AUTO DOOR



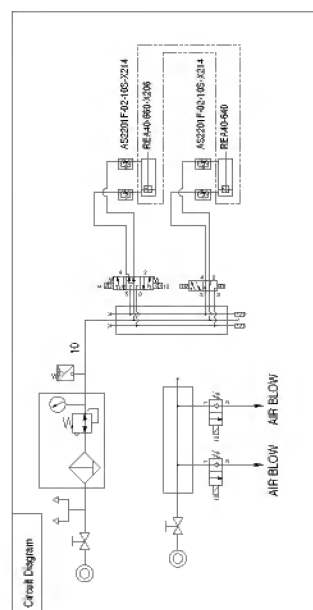
21	AS201F02-105/214	SPEED CON'	4
20	PT38N	NIPPLE	1
19	TU106BU	TUBE	0.1m
18	AN20-02	SILENCER	2
17	SY750-30Z-C10	SO2 VALVE	2
16	WH400 X100-LH	WRENCH BOLT	4
15	SSV17 20-02	MANIFOLD	1
14	NPT14	PLUG	3
13	KG20.10-26S	FITTING	1
12	AF30.42/L1666	PANEL	1
11	KQ2H10-9S	FITTING	1
10	IS1000E 3003	PRESSURE SWITCH	1
9	WH621 01/16-LH	WRENCH BOLT	4
8	AF50-06G	REGULATOR	1
7	Y30T	SPACER	2
6	AF50-06D	FILTER	1
5	PT38EF	ELBOW	1
4	KG2212-05S	FITTING	1
3	PT38T	TEE	1
2	PT12-30DN	NIPPLE	1
1	PT12BV	BALL VALVE	1
No.	SERIAL NO.	PART NAME	QUANTITY



(2) AUTO DOOR & AIR BLAST



27	A5200F-02-105-1214	SPEED CON'	4
26	SY7225-50Z-C10	SOL VALVE 1	
25	W5P112	PLUG	1
24	PT12H	IMPLE	1
23	W4950.6340L-H	WREICH BOLT	2
22	VC455-SOL-4-03	SOL VALVE 2	
21	VY2C45-02	MANIFOLD	1
20	PT38H	IMPLE	1
19	TU1004BU	TUBE	0.1m
18	AN03-02	SLEICHER	2
17	SY7620-50Z-C10	SOL VALVE 1	
16	W4400.7350L-H	WREICH BOLT	4
15	W5517-20-02	MANIFOLD	1
14	KPT14	PLUG	3
13	K02L10-02S	FITTING	1
12	AF91-42.12166	PANEL	1
11	K09H10-05S	FITTING	1
10	S500E-5003	PRESSURE SWITCH	1
9	W4M1.0311L-H	WREICH BOLT	4
8	AR30-03S	REGULATOR	1
7	V300T	SPACER	2
6	AF30-03D	FILTER	1
5	PT8EF	ELBOW	1
4	K02V12-05S	FITTING	1
3	PT38T	TEE	1
2	PT18-350H	IMPLE	1
1	PT12BU	BALL VALVE 2	
PART NAME			REMARK
PART No.			QTY



6.4 Pressure regulation of supplied air

Set up the main pressure when the machine is installed. The pressure is regulated at the regulator installed on the air unit

< Setup method >

- 1) Supply the compressed air.
- 2) Pull down the knob for pressure regulation at the regulator.
- 3) Turn the knob to CW direction to increase the pressure and turn it CCW direction to decrease the pressure. Adjust the pressure to 4 ~ 6 kgf/cm² using pressure gauge.
- 4) After the pressure setup, take off the hand to complete the regulation.

6.5 Air source connection (in case of Filter Regulator device)

The machine pneumatic energy connection must be done by customer directly on Filter Regulator device normally positioned on machine back side.

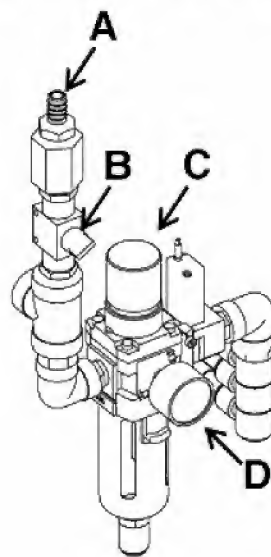
Customer air distribution pipe system must be clean, without condense or residual oil.

The connection must be done using the provided rapid attach and by using pipe minimum diameter 12 mm.

Follow the sequent procedure:

1. Close the regulator C by rotating it CW.
2. Connect the air pipe in A.
3. Open the main valve B by rotating it CCW.
4. Rotate CCW the regulator C until the gauge D sign 5 bar.

Pneumatic Energy connection



7. Structure of machine

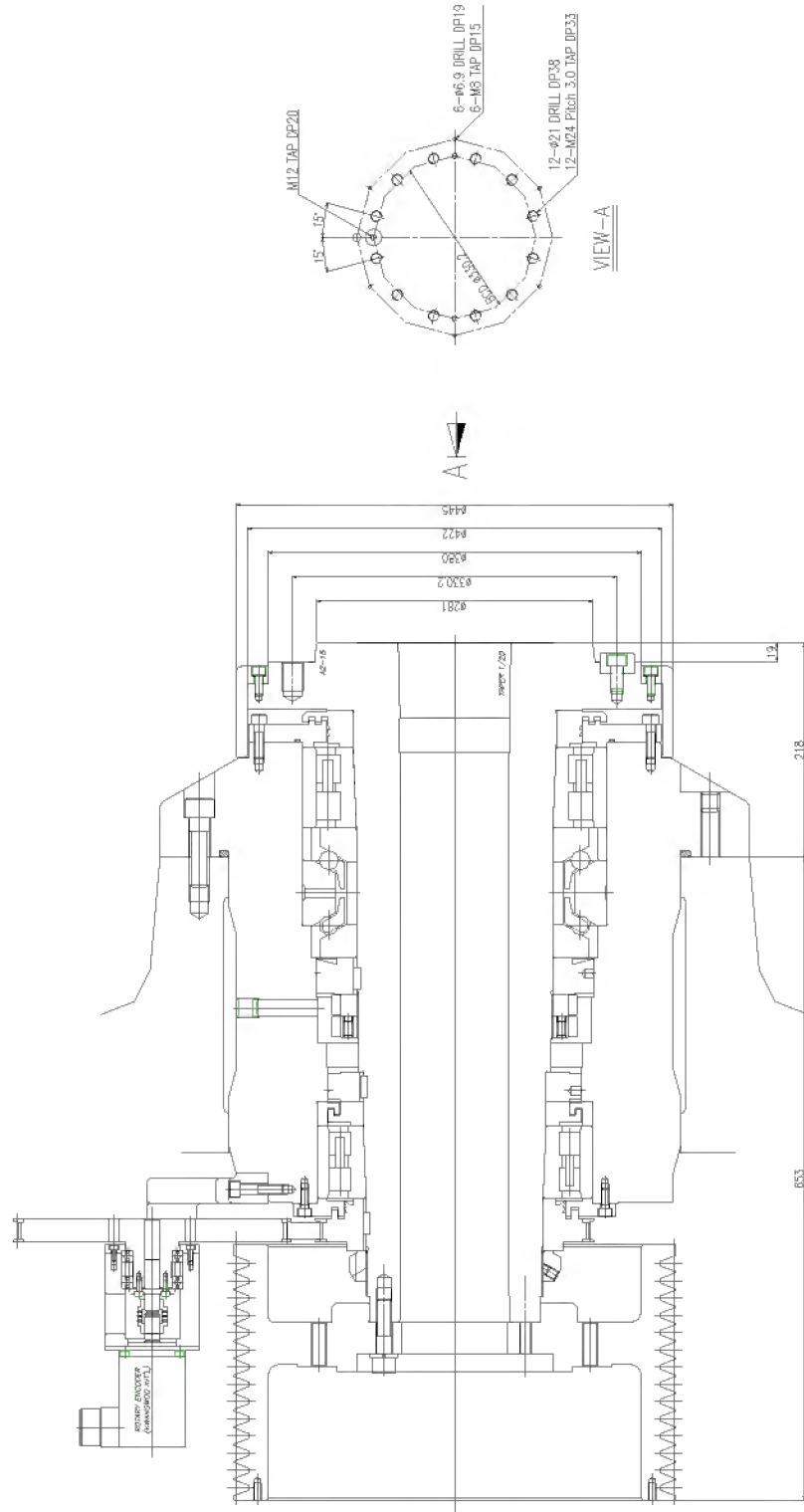
7.1 Intended Use

The machine was built for automatic and semi automatic tool machining of metal product.

7.2 Reasonably Foreseeable Misuse

The machine must never be used:

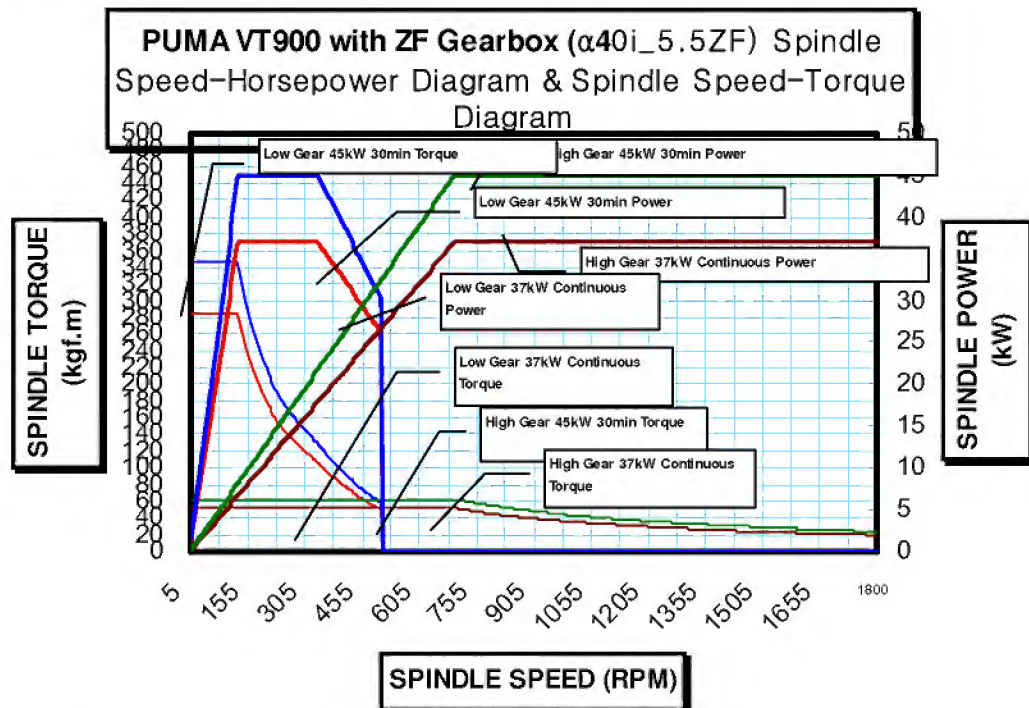
- For machining purpose different from which specified in 1.1;
- In place with explosive atmosphere, corrosive atmosphere or atmosphere with high concentration of oil or dust in air;
- In place with high risk of fire;
- Exposed to ambient condition out of range respect to chapter 4.3 specifications;
- With exclusion of covers, interlock or safety device;
- With electric modification and/or other modifications that exclude some part of the machine;
- To machine products that can form flammable air or explosive air;
- with being exposed to bad weather or exposed to ambient behavior out of range exposed in 4.3;



2. Spindle speed & power diagram

<FANUC>

1) OPTION



<Explanation for the rated output>

As you can see in the spindle speed output diagram on the previous page, there are 37kW continuous rating and 45kW 30min. rating marked. The simple explanations for them are as the following.

(1) Continuous rating

Even if continuous operation is executed on the specified condition (37kW), the temperature rising limits for each insulation or other limits is not exceeded. At that time, motors never be scorched and stuck at any time-long operation if the operation is executed with continuous rating on the generally maintained condition.

(2) Short time rating

Even if short time operation (30minutes) is executed on the specified condition(45kW) at the surrounding temperature(40°C in general) the temperature rising limits for each insulation or other limits is not exceeded.

For example, for 30 minutes rating, if the operation is executed with 45kW, it will take 30 minutes motor to reach the allowable temperature. Therefore, at this time, if the operation stop time is short, the temperature of motor gradually rises to exceed the temperature rising limit. The above is a theoretical explanation for the rating, however, as for our company, the scale of 100% in the load meter indicating the load status of motor means the continuous rating.

3. Spindle centering

When the machine is delivered, adjustment is not required because the center of spindle has already been adjusted based on the accuracy inspection table.

But, if turret is clashed with the spindle stock after delivery, tapering occurs while processing. This phenomenon can be temporarily corrected by programming.

<Program example>

N1 G00 X50. Z1.;

N2 G01 Z-100. F0.1;

N3 G00 X55. Z1.;

Processing is done by the left program.

When the front diameter of taper is 0.1mm larger.

N1 G00 X50. Z1.;

corrected and

N2 G01 X50.1 Z-100. F0.1;

N3 G00 X55. Z1.;

The difference of 0.1mm at N2 should be

taper cutting should be done.

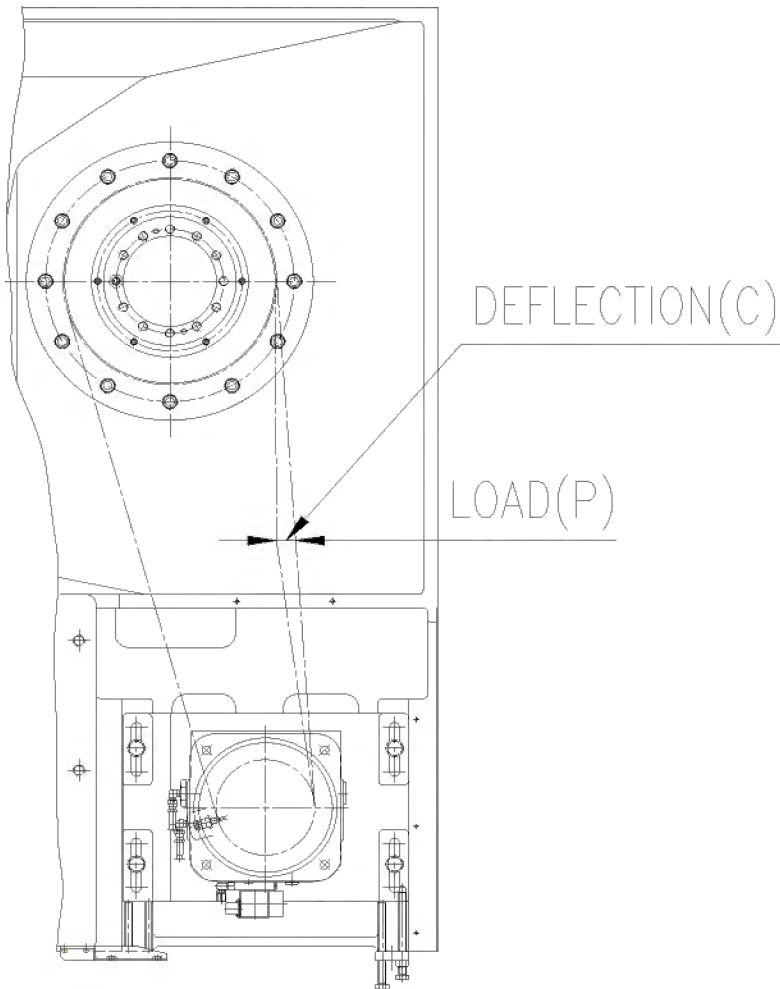
4. Adjusting the tension of the V-belt

The motor and the spindle are linked by a V belt. If the V belt loose, or when replacing the V belt, adjust it so that its tension is as follows. Correct V belt tension is important for its service life.

Specification	Used belt	No	Load	Deflection
5 - 1,800 rpm	5V-1320	14 pcs	7.7 kgf (75N)/EA	18mm

⚠ CAUTION

- Load should be applied to the center of the span as shown below.



7.4 TOOL POST

1. Maintenance and inspection of leaf chain

- 1) Regular Check-up
- 2) Extension of leaf chain

Extension of the leaf chain is increased by abrasion of pins, bushes, etc. Therefore, check the extension regularly, referring to the table below. Replace it in case that the extension exceeds the allowable range.

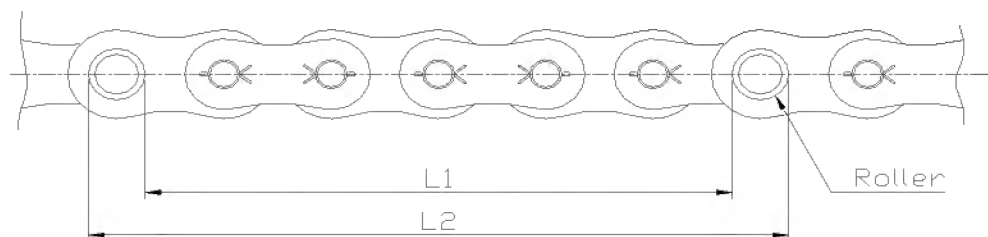
▷ Standard Size for Replacement of leaf Chain

Allowable size	6-link chain	116.01
	10-link chain	193.36

$$\diamond L \text{ (Measured value)} = (L1 + L2) / 2$$

L1 : Inner distance between rollers

L2 : Outer distance between rollers



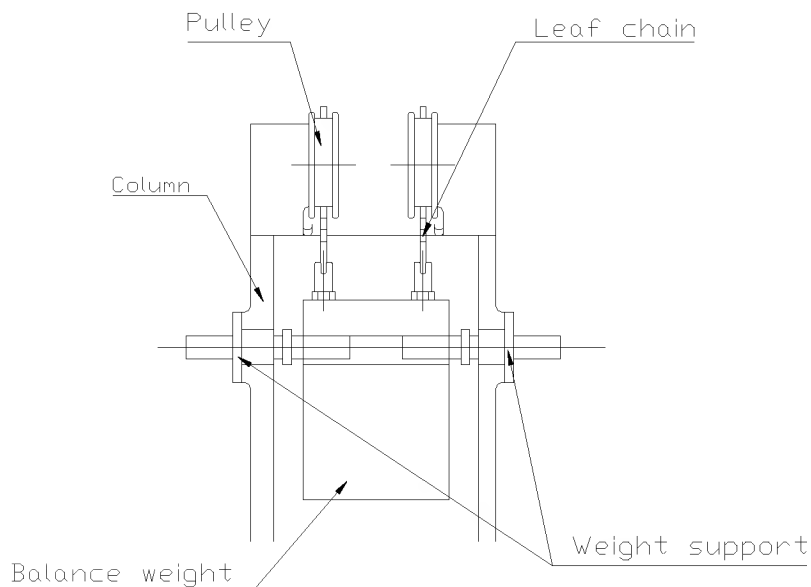
Measuring method

2. Replacement of leaf Chain

The leaf chain can be replaced in the following procedures.

- 1) Move the tool post toward the stroke end in the +X direction (away from the spindle)
- 2) Lower the tool post in the –Z direction (toward the spindle) until the holes of the balance weight and column side are aligned.
- 3) Fix the balance weight with the weight support (round bar) from the column side as shown below.
- 4) Lift the tool post at a low speed, and check that the leaf chain which lifts the balance weight is not loosened. (It is recommended to apply a protective means such as wood, etc. between the base and tool post for safety reasons.)
- 5) Turn OFF power. (The Z-axis motor brake will function at the same time.)
- 6) Remove the old leaf chain and replace with new one.

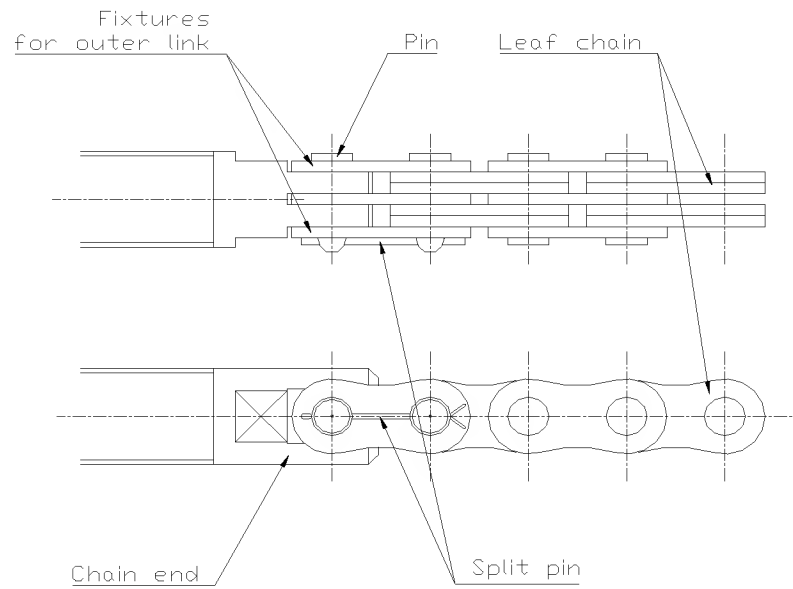
Mounting of new leaf chain can be done in the reverse procedures as shown above.



3. Dismounting of Leaf Chain

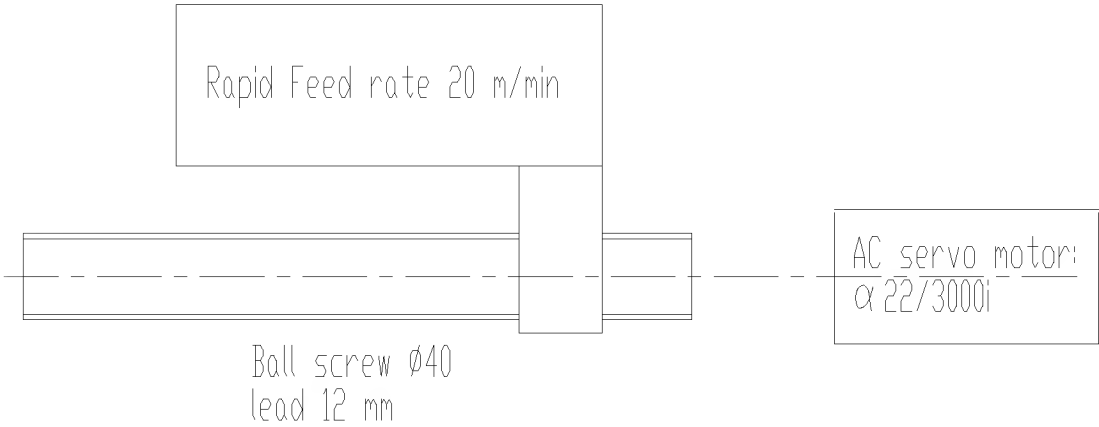
Pull out the split pins, referring to the figure, and remove the pins and fixtures for links.

Note) When the leaf chain is replaced and new split pins are inserted into the pins, bend the ends of split pins.

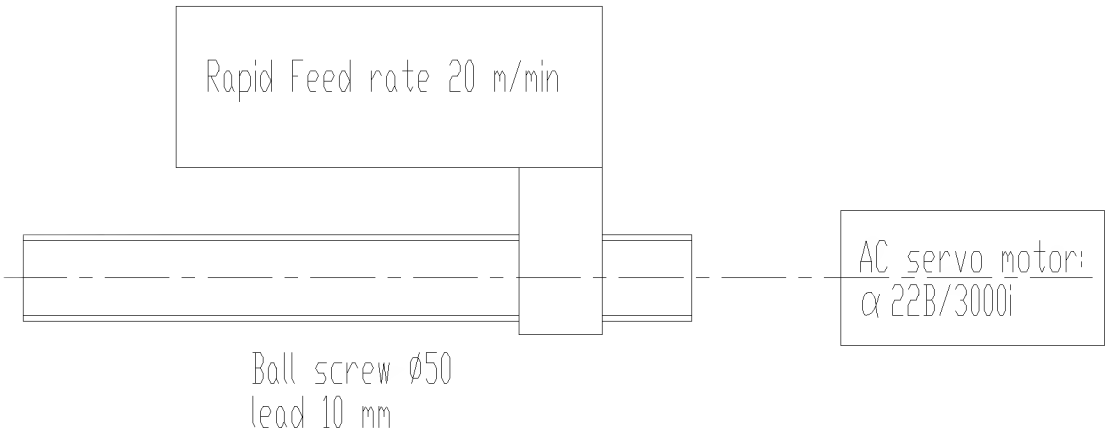


7.5 **Axis feed gearing**

X-AXIS



Z-AXIS



7.6 Coolant system

1. General

The coolant sucked into coolant pump from coolant tank is discharged to the tool and work piece at the L/R turret through pipe to be used for cooling and lubricating of cut point. The discharged coolant is collected into the coolant tank.

2. Specification

The specification of coolant pump used in the coolant system is as the following table.

* According to specification of coolant pump, There are need to exchange parts in control box and change current setting

MODEL		ACP-900HMF(S)45		ACP-1500HMF(S)70		ACP-2200HMF(S)100		ACP-3700HMF(S)145	
Pump	Total Head(m)	30	45	50	70	70	100	100	145
	Dis. Vol (ℓ/min)	20 (10~80)	20 (10~90)	20 (10~80)	20 (10~90)	20 (10~80)	20 (10~90)	20 (10~80)	20 (10~90)
	Pipe Size (Ps)	$\frac{3''}{4}$		$\frac{3''}{4}$		$\frac{3''}{4}$		$\frac{3''}{4}$	
Motor	Phase	Ø3		Ø3		Ø3		Ø3	
	Poles (P)	2		2		2		2	
	Motor power (Kw)	0.9		1.5		2.2		3.7	
	Frequency (Hz)	50	60	50	60	50	60	50	60
	Voltage (V)	220~230/ 380~415	220~240/ 380~440	200~230/ 380~415	220~240/ 380~440	220~230/ 380~415	220~240/ 380~440	220~230/ 380~415	220~240/ 380~440
	Current (A)	4.3~3.8/ 2.4~2.1	5.2~4.8/ 3.0~2.6	6.9~6.6/ 4.0~3.8	7.6~7.3/ 4.4~4.3	10.0~9.6/ 5.8~5.6	11.0~10.5/ 6.4~6.1	15.6~14.8/ 9.0~8.6	18.0~17.0/ 10.4~9.8

3. Coolant

OBSERVANCE

For water soluble coolant, emulsion type oil is recommended. Other kind of water soluble coolant may cause problems about electricity disconnection or corrosion of nonferrous metal(zinc, in particular), so, be careful on selection. In summer, because water is extremely evaporated, the concentration of coolant should be managed by replenishing water timely. When the machine is installed, test working is done or it is not used for long period, use enough spare water. Coolant gauge is attached on the front side of coolant tank.

- 1) Select the coolant considering the lubrication, infiltration, anti-corrosion, bubbling, segregation from oil and stability etc.
- 2) When starting and finishing the day's work, not only remove chips, but also apply the lubricant on the rotation part or toolpost etc. after properly wiping the coolant on them.
- 3) Replace the coolant immediately when it's gone bad.
- 4) Clean the slide way of each spindle, limit switch and feed motor about once a half year.
- 5) The anti-corrosion is considered for water soluble coolant, but be careful since rust may be produced when it's dried.
- 6) The coolant is alkaline, which has the strong property of removal of grease.
- 7) The diluting method and diluting oil of coolant vary depending on the kinds. Follow the instruction of the coolant maker

OBSERVANCE

There are many kinds of coolant.

Our company doesn't designate a coolant, but, for the decision of using oil, get the enough counsel from the oil maker for the following items.

- 1) Any components badly influencing human body such as bad smell and pollution are not contained.
- 2) Quality is not changed while stored.
- 3) Rust should not be generated on the machine.
- 4) Paint should not peel off the car.
- 5) The rubber of machine should not be expanded.
- 6) Processing accuracy should not be lowered.
- 7) Be careful as we don't guarantee the troubles generated by the coolant.

4. Coolant tank cleaning

If there are fine chips deposited and piled in the tank, even though normal oil level is kept, coolant is not discharged to the cut position. And, if such coolant is sucked into the coolant pump, the life span of pump is shortened. Inside of the tank should be cleaned at least once per 5,000 hours of operation.

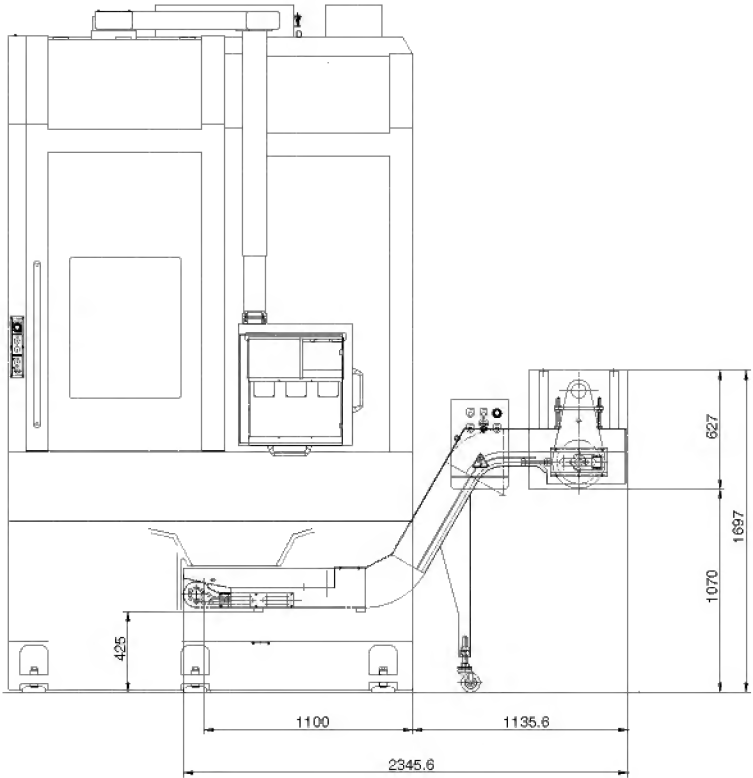
5. Coolant pump breakdown

Content of breakdown	Cause	Treatment
Motor doesn't rotate	Connection is cut off.	Repair or exchange.
	Fuse is blown.	Replace it with new fuse, and examine the reason.
	Electromotor break down.	Exchange.
	Foreign substance get caught in the impeller.	Disassemble, Repair.
	Oil seal, bearing and metals etc. are pressed and stuck.	Disassemble, Repair.
	Spindle related part rusts.	Disassemble, Repair.
	Switch contact status is bad.	Examine the contact part.
Pumping is impossible even if the electromotor works.	Rotation speed is low.	Examine and investigate with a tachometer
	Pipe inside is blocked up with foreign substances.	Check the pipe and clean it.
	Pump part is not dipped into coolant.	Replenish coolant in the tank and examine the reason.
Even if pumping is possible, the designated lift is not reached.	Impeller casing is blocked up with foreign substances.	Disassemble, Repair.
	Impeller is worn.	Disassemble, repair or exchange.
	There is oil leakage in the discharging pipe.	Check, Repair.
	Spindle speed is lowered.	Examine and investigate with a tachometer.
	Regulation valve is locked.	Open the regulation valve.
	Pipe inside is blocked up with foreign substances.	Check the pipe and clean it.
	Pump strainer (filter) is blocked up.	Check and clean the filter (strainer).
Electromotor is overloaded.	Specific gravity or viscosity of coolant is easy to get large.	Examine coolant.
	Rotation part is contacted.	Exchange it.
	Discharging quantity is too much.	Lock the regulation valve.
	Voltage is dropped.	Contact with an electric company.
Pump vibration and noise occur.	Foreign substances are caught in some part of impeller which becomes unbalanced.	Disassemble and check it.
	Bearing or spindle metal is damaged.	Disassemble and check it.
	Cavitation is generated.	Consult the maker.

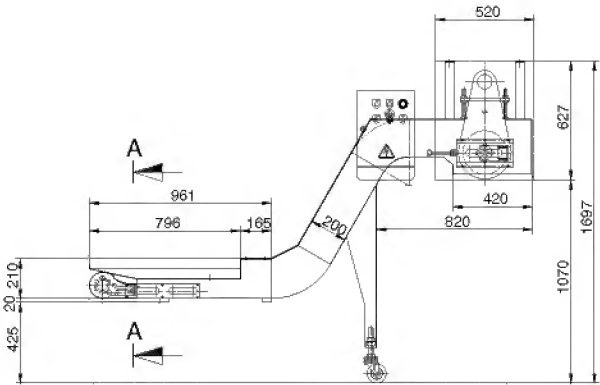
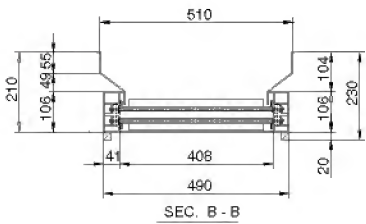
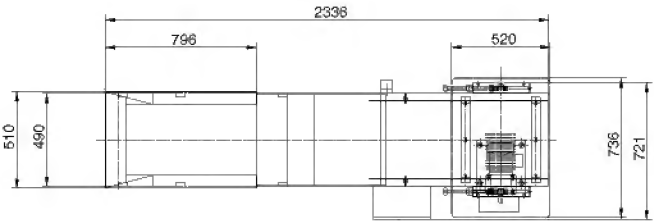
7.7 Chip conveyor

1. Specification

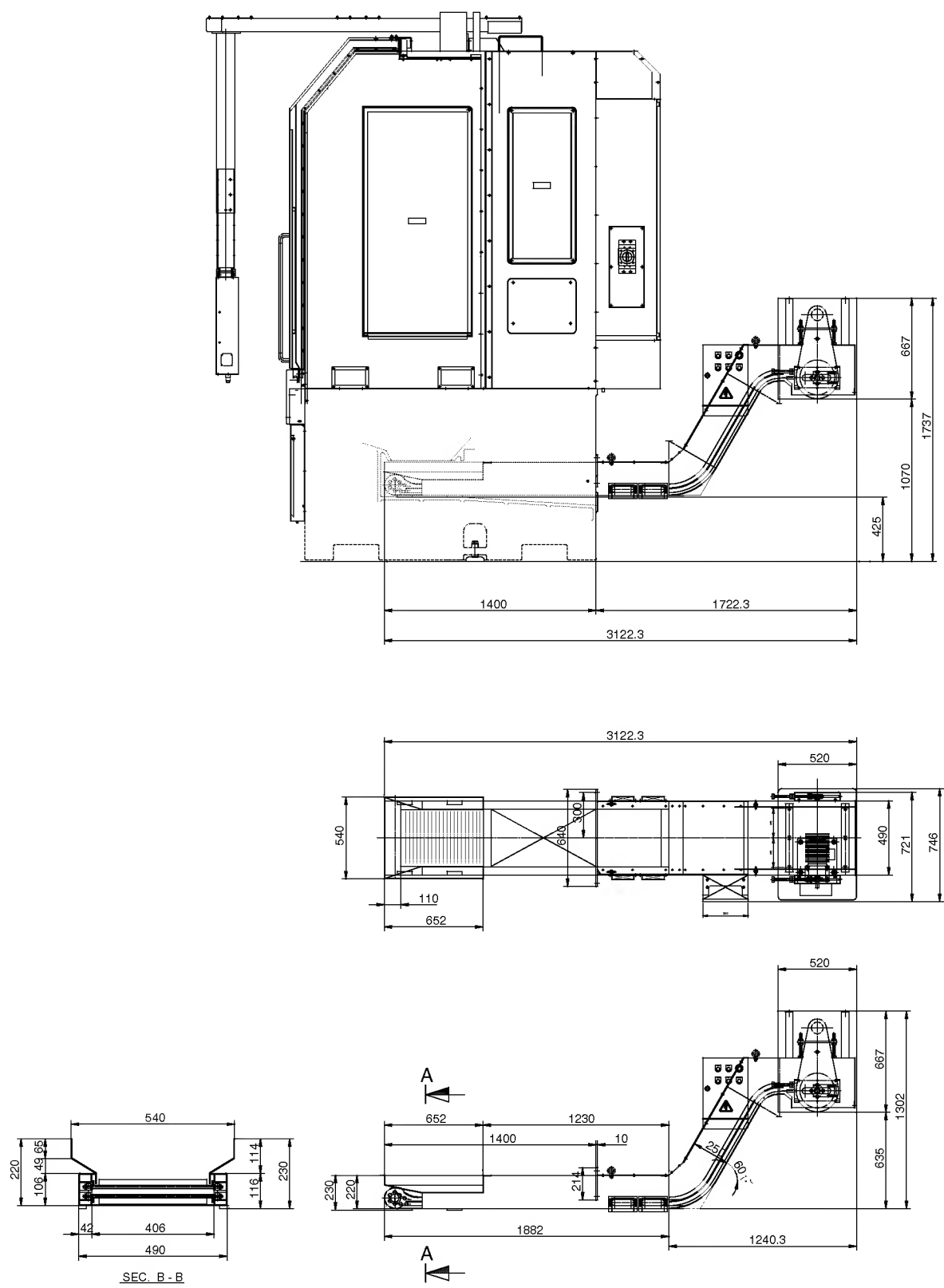
1) A TYPE(SIDE)



SPECIFICATION	
GEARD MOTOR	0.4KW X 200/200V X 50/60HZ X 1/75 LH
SPEED	2.1 M/min
MAIN CHAIN	RF2060R
DRIVE CHAIN	RS50
SAFETY DEVICE	TORQUE LIMITS
HEAD BEARING	SWUCT205



2) B TYPE (REAR)



2. Cautions for installation

OBSERVANCE

- 1) Chip conveyor has been made for the indoor use fundamentally. When it is used outdoors, consult our company on that.
- 2) Gear motor should be horizontally installed.
- 3) Firm fixing is required to prevent vibration during operation.

3. Cautions for operation

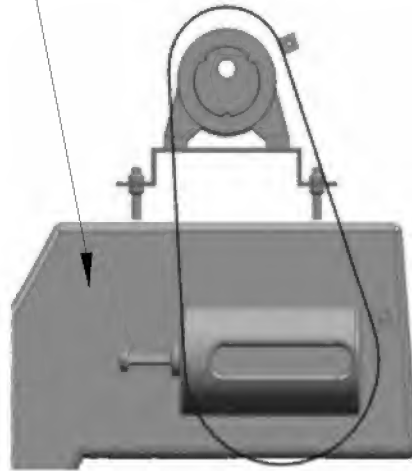
⚠ CAUTION

- 1) Chip conveyor is delivered after complete test working. Confirm and check whether the adjusting bolts are loosened during installation or transportation. – Confirm the unfastening status of chain belt.
- 2) Confirm whether there are foreign substances on the conveyor belt, and remove them.
- 3) Confirm whether there are enough lubricant in the speed reducer of gear motor.
- 4) When the operation is done for the first time, switch on and confirm the direction of rotation. (When the rotation is reversed, electric connection should be corrected.)
- 5) While chips are discharged from the processing machine, be sure to operate the conveyor continuously.
Intermittent operation, Such as rotation and stop repeatedly causes trouble for the motor or belt.

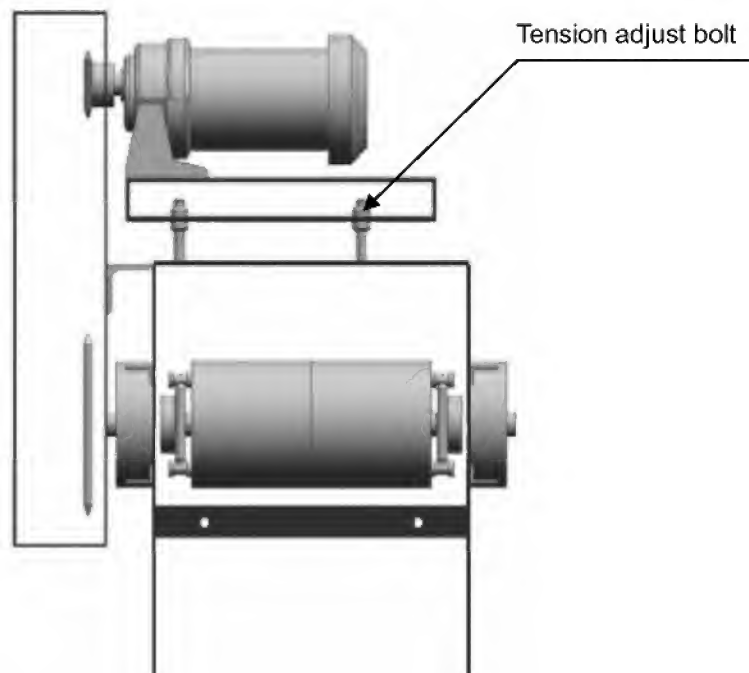
4. Repairing

- (1) Be sure to keep the oil of speed reducer at a fixed quantity.
- (2) Exchange oil every 1,500-2,000 hours after the first 300 hours.
Grease fill type oil should be replenished every 3-6 months.
- (3) Examine the thermocurrent and noise of the motor.
- (4) Be sure that the chain belt tension can be normally transmitted to the bearing.

Chain belt Tension adjust bolt



- (5) Confirm whether the roller chain between the motor and the drive sprocket gets normally pressed or the tension is normal



5. Lubrication

For conveyor chain and roller chain, oiling is required every 150 hours.

Recommended lubricant (JIS K2219 GEAR OIL)

Surrounding Temp.	-15°C - 15°C	4°C - 40°C	40°C - 65°C
Speed reducer	Class 2, No. 3 - 4	Class 2, No.4 - 5	Class 2, No. 5 - 6
Roller chain Conveyor chain	Class 1, No.1 - 2	Class 1, No. 2 - 3	Class 1, No. 3 - 7

When oil is exchanged or supplied, refer to the above table to select and use proper oil.

6. Cause of breakdown and treatment

If a conveyor is used for long time, the wear and breakdown of the parts may be caused.

Therefore, frequent checking and confirming should be done to take proper action.

Status	Cause	Treatment
Conveyor doesn't work	Torque limiter slips.	Torque nut adjustment
	Operation of T.H.R	T.H.R setting at the proper value.
	Short circuit of brake.	Brake setting
	Fuse cut off	Fuse replacement
	Entrance of foreign substances	Removal of foreign substances
	Excessive load and chip matted	Reduction of load weight and removal of chip matted.
	Cable cut off	Exchange cable
	Chain belt damaged	Exchange chain belts.
Knocking occurred	Bad tension adjustment	Adjust tension bolts.
Noise occurred	Insufficient lubricant	Replenish lubricant
	Inferior bearing	Exchange bearings.

7. Periodical inspection

Daily inspection items

- 1) Is a fixed quantity of the oil of speed reducer kept? (Grease fill type, unnecessary)
- 2) Is there noise or heat occurred on the motor?
- 3) Is the oiling status to the conveyor chain and the roller chain good?

Monthly inspection items

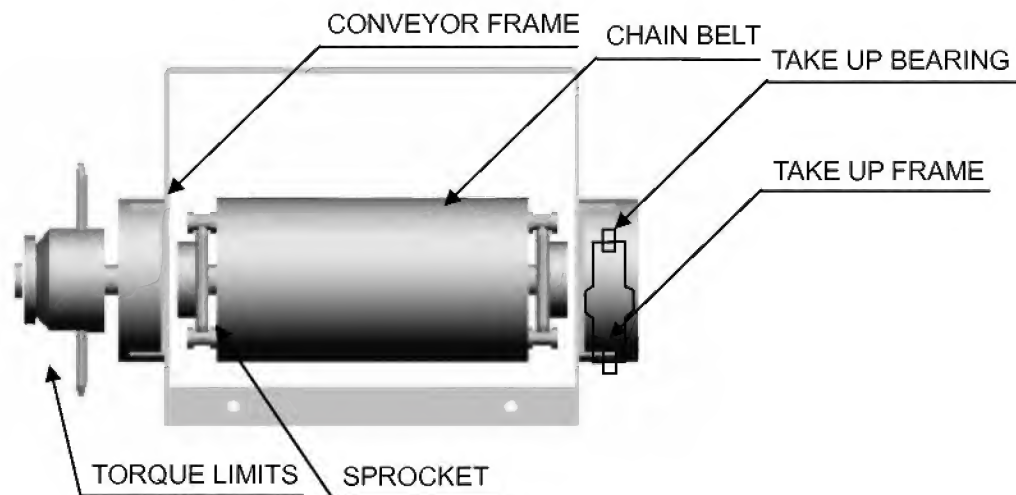
- 1) Exchange oil every 1,500-2,000 hours after the first 300 hours.
- 2) Examine the thermocurrent and noise of the motor.
- 3) Be sure that the tension of conveyor chain can be normally transmitted to the take-up bearing.
- 4) Confirm whether the roller chain between the motor and the conveyor gets normally pressed or the tension is normally adjusted.
- 5) Be careful, while oiling onto the roller chain, that oil would not be applied onto the rubbing board of torque limiter.
- 6) For conveyor chain and roller chain, oiling is required every 150 hours.

Annual inspection items

- 1) Execute all of the monthly inspection items.
- 2) Dismantle the belt and clean the inside of frame.
- 3) Confirm whether there are any parts damaged in the inside of frame and the belt assembly and exchange them.
- 4) Check the status of bolt's contact part.
- 5) Confirm wear condition of the rubbing board of the torque limiter and replace it, if necessary.

8. Conveyor system

<DRIVE, IDLE SHAFT>



<Torque limit system>

If LS started and the conveyor stopped due to overload, get it come back as the following.

- 1) Examine the cause of overload and eliminate it.
- 2) Loosen the belt to make the collar loose.
- 3) Push the dog into the holder.
- 4) Fix the bolt with the collar not contacted with the pin.

<Proper torque>

Torque of adjusting nut.	1~1 1/2	2~2 1/2
Torque (kg·m)	30 - 36	40 - 46
Chip	Al, FC, S-C	Steel, etc

<Dismantlement of the conveyor belt.>

- 1) Dismantle the roller chain for conveyor operation.
- 2) Dismantle the torque limiter and the sprocket wheel.
- 3) Loosen the right/left tension adjust bolt of the conveyor belt equally.
- 4) Disassemble the right/left division pin of the conveyor belt, and the washer.
- 5) Then, disassemble the pin striking on it with a wooden hammer
- 6) Assembling procedure is identical to the reverse of the disassembling.

9. Caution**OBSERVANCE**

If the chip conveyor is installed on the machine, use it after the following cautions are recognized and comprehended. There is a speed reducer attached on the chip conveyor. Periodic oiling is required for the oiling positions. Because, if the conveyor is used for long time, the chips which are carried or passed through the belt side are stuck and piled onto the bottom part and chain of the conveyor, when the every week operation is completed, put and pass a paper duster into the conveyor to clean the chips piled under the conveyor. The conveyor should not be intermittently operated. Even in that case, the fine chips are piled between the belts and the lower part of the conveyor, which causes big resistance during operation and breakdown.(thermal deformation etc.) Be sure to operate it continuously. Chip conveyor is a device which discharges chip out of the machine, however, it's not available for all kinds of chips. Cutting condition should be considered to make chip discharging easier.

8. Daily inspection

8.1 Preliminary remarks

This section deals with the maintenance requirements which must be met by every user in order to insure excellent, trouble-free performance and prolonged life.

It also outlines some basic steps to pinpoint possible causes of trouble, together with troubleshooting hints, if your machine is found out of order in any way, or in need of readjustment or repair.

8.2 Particular precautions

Maintenance operation described in this chapter is easy but can expose the operator to risks if not executed in the right way.

For this reason, first to start any kind of job, we recommend to read all of the following indications:

- All of the verification and maintenance operation reported in the following paragraph must be done when machine is in "Maintenance State" as described in chapter 1.3 "Maintenance states".
- Maintenance operation must be done only by authorized and trained operators with basic machine knowledge, check chapter 2.2 "Maintenance Man/Woman" of Section A.
- All of the operation must be done by only one operator to avoid dangerous sequence error of coordination action.
- Never go on top of the machine because it's not built for this purpose.
- Lock always the vertical axes by using wooden blocks or iron bar before any maintenance operation.
- Pay attention to not sparse coolant or other material dangerous for the ambient.
- Use always individual protection device (glasses, gloves, shoes, etc) right for the operation to do.
- Keep clean and ordered inside working area to reduce the risk of forgotten tools on machine moving parts.
- At the end of the operations, all of the fixed and movable guards with interlock and protection device must be fully functional.

8.3 Maintenance state

All of the verification and maintenance operation described in this chapter must be done under specific machine conditions, we can classify them into three machine states:

1) Normal work

Normal work means the full machine operability, all of the energy sources are available and connected, command circuit are active.

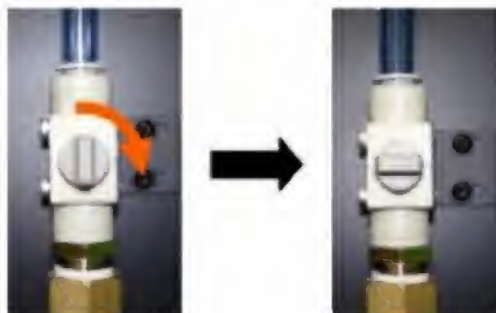
2) Insulation

Insulation state means that all of the energy sources must be off and sectioned:

1. Close the main switch of electric energy placed on electric cabinet by rotating it CCW.



2. Close the pneumatic energy by rotating the main valve by rotating it CW.



3) Maintenance insulation

Same condition as Insulation, but also the operator must:

- Attach in a well visible position on machine a label with the following sentence:

"MAINTENANCE STATE"

8.4 Check of safety device

At least once every month the following procedure must be executed by machine maintenance operator for safety device verify.

1) Emergency Switch Push Buttons

For every emergency switch push buttons, set the machine in ready state for normal automatic functionality:

1. Without any work piece inside, command cycle start.
2. Press emergency switch push button and verify that machine stop immediately all of the movement.
3. Unlock and reset the emergency switch push button and verify if it is possible to regularly restart the machine.
4. If something abnormal is found, please contact immediately the authorized service company.

2) Interlocking Device

For every interlocking device, set the machine in ready state for normal automatic functionality:

1. Without any workpiece inside, command cycle start.
2. Try to open the cover and verify if it is locked.
3. Stop the working cycle, open the cover and verify if it is impossible to execute command or movements.
4. Turn the main modal key selector in manual-maintenance position and verify if it is impossible to command start, the axes speed in jog is max 2000mm/min and spindle jog is max 50rpm; in this case jog means that the command must be keep pressed, if released the movement immediately stops.
5. If something abnormal is found, please contact immediately the authorized service company.

3) Hydraulic Pipe

All of the hydraulic pipes used in spindle chuck, tailstock, steady rest, tool systems and other device like balancing system must be visually checked for verify the integrity and the absence of damage, leakage due to heavy use.

If something abnormal is found, please contact immediately the authorized service company.

4) Transparent Panels of covers

Transparent panels must be visually inspected for verify it's integrity:

- Verify the absence of deformation, break, opaque area, coolant leakage inside layers, corrosion and so on.
- After 10 years of work all of the transparent panel must be changed even if they are in good state.
- Panel cleaning action must be done by using soft cloth with common glass or plastic grease-cleaning liquid agent.
- Panel change operation must be done by authorized service company.

8.5 Periodic inspection schedule

To insure a maximum productive time with a minimum of downtime, the machine must be periodically inspected and carefully serviced.

A periodical inspection schedule is presented below. In addition to the regular maintenance items given here. There are some maintenance items which should be checked according to the actual condition of the machine, as described in this section.

Periodical Inspection Schedule

No.	Inspection	Inspection Item	Frequency				
			Daily	Weekly	Number of months		
					1	6	12
1	General	Arranging the machine periphery in order, cleaning the machine and its periphery (especially, the floor)	<input type="radio"/>				
2	Headstock (Main/Sub)	<ul style="list-style-type: none"> - Checking the chuck unit and its periphery to scan for chips - Checking for secure mounting of the top jaws - Checking for smooth clamping/unclamping of chuck - Greasing the chuck jaw - Removing any chips from the coolant collector 	<input type="radio"/> 	<input type="radio"/>	<input type="radio"/>		
3	Tailstock	<ul style="list-style-type: none"> - Checking the tailstock spindle to scan for chips - Checking the tailstock body and tailstock spindle for smooth forward backward movement 	<input type="radio"/> 				
4	Tool post	<ul style="list-style-type: none"> - Checking for secure mounting of the cutting tools and the holder - Checking the turrets and the cutting tools to scan for chips 	<input type="radio"/> 				

No.	Inspection	Inspection Item	Frequency				
			Daily	Weekly	Number of months		
					1	6	12
5	Guideway and wipers	<ul style="list-style-type: none"> - Checking the wipers for abnormalities such as damage - Checking for unusual operating sounds during tailstock or sub-spindle movement 	○			○	
6	Lubrication unit	<ul style="list-style-type: none"> - Checking the oil levels, and if necessary, refilling - Checking the oiling filters - Checking for oil leakage and for damaged piping 	○				○ ○
7	Hydraulic power unit	<ul style="list-style-type: none"> - Checking for appropriate pressure - Checking the oil levels, and if necessary, refilling - Checking the strainers - Replacing the hydraulic oil - Checking for oil leakage and for damaged piping 	○ ○			○ ○ ○	

Periodical Inspection Schedule (continued)

No.	Inspection	Inspection Item	Frequency				
			Daily	Weekly	Number of months		
					1	6	12
8	Coolant unit	<ul style="list-style-type: none"> - Checking the coolant levels, and if necessary, refilling - Checking the degree of dirtiness of the filters and cleaning - Checking the degree of dirtiness of the coolant and if necessary, replacing 	○ ○		○		
9	Air unit	<ul style="list-style-type: none"> - Checking the element and if necessary, replacing 				○	
10	Name plates	<ul style="list-style-type: none"> - Checking the name plates for abnormalities such as damage or missing - Please order our nearest service center, if necessary 	○ ○				
11	Q-setter (option)	<ul style="list-style-type: none"> - Cleaning the sensor section and removing any chips - Checking for sounds of reaction during sensor contact 	○	○			
12	Electrical control cabinet	<ul style="list-style-type: none"> - Checking if the door is fully closed - Checking the electrical components for dirt and discoloration and checking for loose terminal screws 	○			○	
13	Connectors	<ul style="list-style-type: none"> - Checking for loose connector/terminals between units 				○	

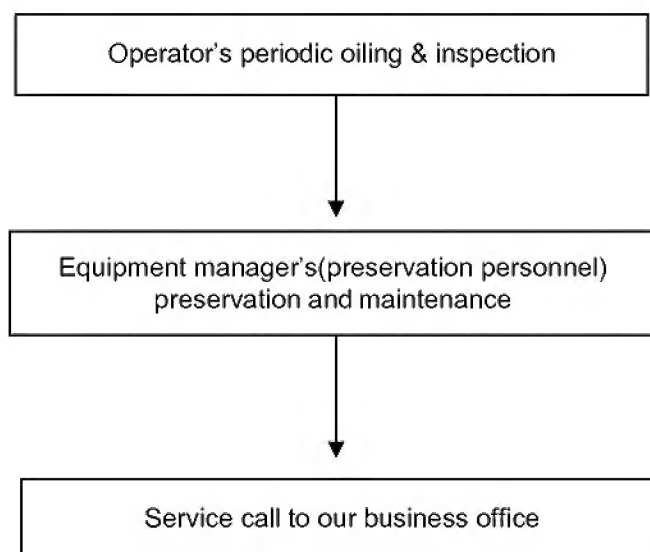
No.	Inspection	Inspection Item	Frequency				
			Daily	Weekly	Number of months		
					1	6	12
14	Foundation	- Checking and adjusting the bed level using a level					○
15	Emergency switch push button	Refer to chapter 1.4 "Check of safety device"			○		
16	Interlocking device	Refer to chapter 1.4 "Check of safety device"			○		
17	Hydraulic pipe	Refer to chapter 1.4 "Check of safety device"			○		
18	Transparent panels of covers	Refer to chapter 1.4 "Check of safety device"	10 years				

8.6 Inspection and maintenance

CAUTION

Operators are required to comprehend the functions & performances of the machine, and be aware of the way to use it in order to fully and properly use the machine. Daily inspection should be executed base on the Daily Oiling Chart and Daily Inspection Items described in this chapter.

Operator's daily oiling & inspection is related to the maintenance of the machine accuracy for long time. The results of the operator's inspection should be informed the equipment manager of them. The equipment manager should preserve the result report and correspond to it. Contact our business office for the problems that is impossible to correspond to or that the cause is indistinct.



8.7 Handling of oil

CAUTION

Be sure to use the oil recommended by DOOSAN.Infracore CO., LTD. Do not use mix the oil of another maker's. Our company is not responsible for the breakdown of machine by using another oil except the recommended oil

1. Recommended Oil & Grease

No.	Position to be supplied	Name			Remarks	
		Esso	Shell	Mobil	PUMA VT900	PUMA VT900M
1	Spindle bearing				Grease NBU15	
2	Hydraulic unit	Teresso 32	Tellus Oil C32	DTE Oil Light	10 liter	10 liter
3	Lubrication tank			Vactra No.2	4 liter	
4	Coolant tank (Chip pan)	Cutwell 40, Stancool S518	Dromus Oil B, Dromus Oil F	Solvac 1535G	PUMA VT900	PUMA VT900-2SP
					400 liter	400x2 liter
5	AIR unit lubricant	Teresso 32	Tellus Oil C32	DTE Oil Light	Emulsion type	

2. Storage of oil

OBSERVANCE

Storing a large quantity of oil purchased, take the following cautions. And, it is recommended that necessary quantity of oil be purchased if possible.

- 1) Oil should be stored at the place free from rain and a direct ray of light.
- 2) Be sure that dust or water don't get into the oil during storage.
- 3) Never use the oil which is deteriorated or foreign substances mixed into.
- 4) If an intermediate tank is used, get rid the dust or moisture of its inside at least once a year.

3. Cautions for oiling

OBSERVANCE

- 1) Make sure to use a dedicated oil jug for oiling. Do not use another one.
- 2) Oiling should be done necessarily in the state that the filter of the oiling port of each tank get attached.
- 3) When an unspecified oil is supplied or the oil is mixed, quickly wash the tank pipe.

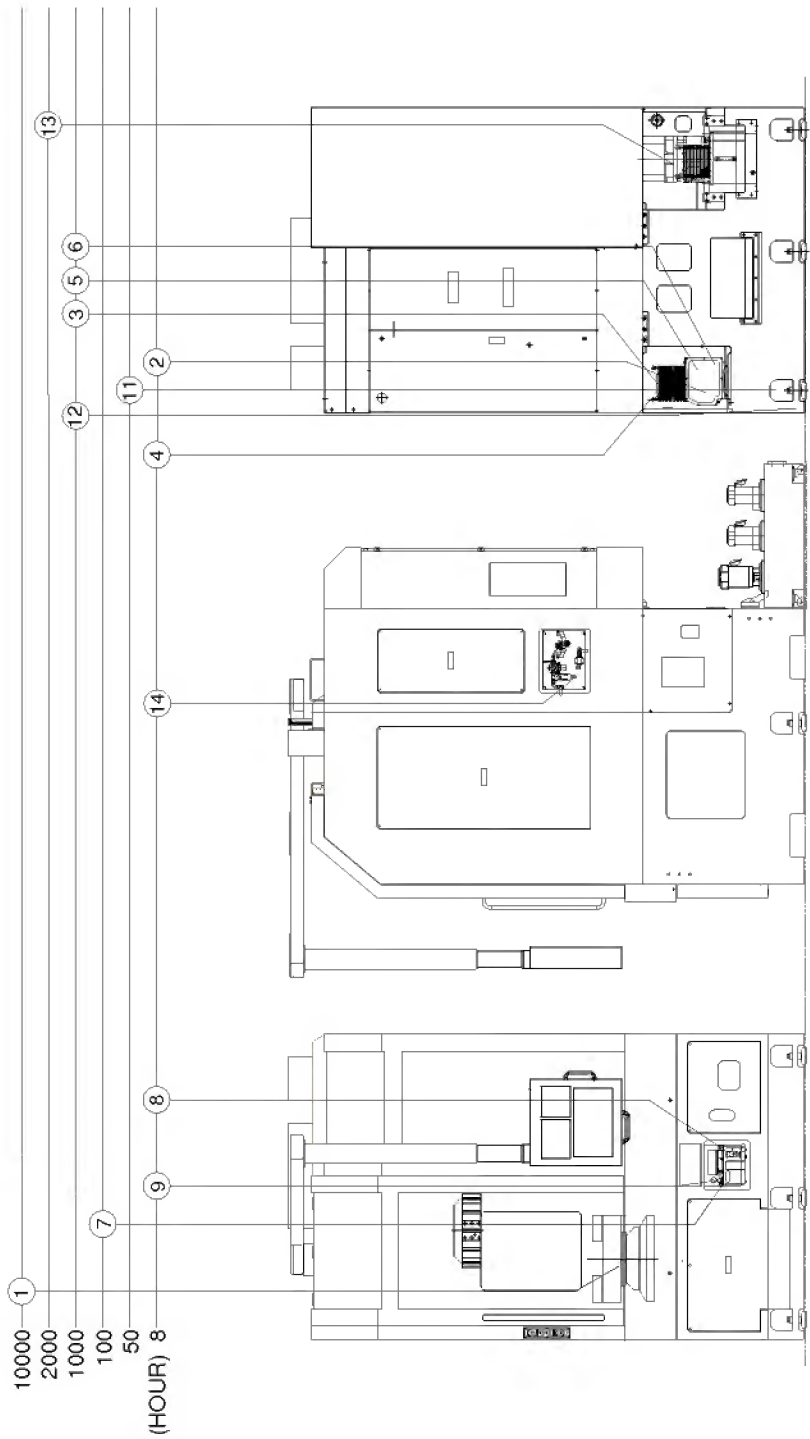
4. Disposal of waste oil

The disposal of industrial wastes without permission is prohibited by law.

Do not dispose the waste oil without permission.

Make the waste oil trader a request necessarily.

8.8 Oiling chart



Lubrications point		Headstock	Hydraulic unit				Turret, carriage slideway				Coolant		Gear box		Auto door
Part Number		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Control item	SYNMOX														
Checking interval (h)															
Replenishment (H)			8					100	8	8		50			8
Cleaning of splash(H)															
Replenishment (H)				1000		1000	1000				1000				
Tank capacity(l)										4				2000	
Replenishing amount(l)		0.22										250		1.5	
Replenishing amount(l)															
Oiling method		No. 1 Clean the specified parts before oiling. No. 2 Supply the specified lubricant from the filter port to the specified level. No. 3 Supply the specified lubricant from the filter port to the specified level. No. 4 Supply the specified lubricant from the chip pan to the specified level. No. 5 Supply the specified lubricant from the filter port to the specified level. No. 6 Supply the specified lubricant from the filter port to the specified level.													

Note1 : Clean the lubricating parts before oiling.
Note2 : Refer to the list of lubricants on the next page for lubricant types.

8.9 Oiling procedures

The operator should supply oil to each oiling position based on 9.3 Daily Oiling Chart

1. Oil supplying into lubrication tank

< Procedure >

- 1) Confirm the quantity of lubricant with the oil gauge of the lubricant tank.
- 2) Take off the cap of oiling port of the lubricant tank.
- 3) Supply the oil with the dedicated oil jug confirming the oil quantity with the oil gauge.

2. Oil supplying into the coolant tank

< Procedure >

- 1) Stop the coolant tank.
- 2) Confirm the quantity of oil with the liquid level gauge.
- 3) Supply the coolant through the top of the chip conveyor.

3. Oil supplying to the master jaws of chuck

< Procedure >

- 1) Stop the spindle rotation.
- 2) Supply the grease through the grease nipples(3ea.) placed on the chuck circumference by grease gun.

OBSERVANCE

If the coolant get caught into the chuck, the grease streams down, Increase the frequency of oil supplying a day.

4. Oil supplying to LM Guide

< Procedure >

- 1) Stop the loader operation.
- 2) Supply the grease through the grease nipples placed on each LM Guide by grease gun.

5. Oil supplying to the bearing of chip conveyor

< Procedure >

- 1) Stop the chip conveyor.
- 2) Take off the bearing cover of chip conveyor.
- 3) Supply the grease through the grease cap of chip conveyor operation part.

8.10 Operation inspection

1. Prior to the power on

< Inspection item >

- 1) Confirm that there are not any matters around the machine.
 - a) External piping
 - b) Cable disconnection, coating damage.
 - c) Check that each door of the machine isn't open.
- 2) Confirm the floor around the machine.
 - a) Leakage of coolant
 - b) Leakage of hydraulic oil
 - c) Leakage of lubricant
 - d) Obstacles to the operation
- 3) Confirm that the tool post places to the stroke end of X axis.
- 4) Confirm that the hydraulic pressure gauge is at zero (0).
- 5) Confirm that the air pressure gauge is at zero. (0)

2. After the power on

- 1) Confirm the sound when the hydraulic unit is operated.
- 2) Confirm the Main hydraulic pressure. (PUMA VT900:35 kgf/cm²/ VT900M: 45 kgf/cm²)
- 3) Confirm the chuck pressure.
- 4) Confirm the compressed air pressure. (4 ~ 6 kgf/cm²)
- 5) Confirm that the cooling fan on electric box is revolving
- 6) Confirm that the switches and lamp functions of the control panel are normal.
- 7) Confirm that the alarm is displayed on the screen.

3. Inspection before the automatic operation

- 1) Confirm the installation state of tool holder.
- 2) Confirm the installation state of bite.
- 3) Confirm the installation state of tip.
- 4) Confirm the installation state of the top jaw of chuck.
- 5) Confirm whether the jigs are fixed.
- 6) Confirm the lubricant is supplied to the operating side.
- 7) Confirm whether the wipers and slide seal are damaged or not.

8.11 Inspection during the automatic operation

- 1) Confirm the rotation sound and vibration of the spindle.
- 2) Confirm the motor sound of the spindle.
- 3) Confirm the vibration of moving axis during continuous operation.
- 4) Confirm the load value with the spindle load meter on operation panel.
- 5) Confirm whether the processing accuracy is maintained.

8.12 Inspection after the operation ended.

- 1) Clean the inside of the machine.
- 2) Discharge the chips on the chip conveyor.

8.13 Cleaning of the inside of machine

1. Cleaning of the spindle front cover

WARNING

If the worker should enter the machine to do the work, make sure to cut off the power and turn off the main switch.

OBSERVANCE

- If the coolant exhaust port of the spindle front cover is clogged with dust or leftov infiltrated to the bearing part, which causes the bearing pressed and stuck. Remove a week.
- Do not use the compressed air. Dust or leftovers may be infiltrated to the bearing part.

2. Cleaning of the slide cover on the operating side

OBSERVANCE

When dry cutting or casting is executed, clean the machine carefully so that chips cannot be collected into the machine. In particular, if the chips are piled on the operating part of the protect cover, normal operation is disturbed, which becomes the cause of breakdown.

8.14 Warming up of the machine

1. Warming up before the automatic operation

OBSERVANCE

Before the automatic operation, warm up the spindle and moving axes to maximally control the influence on the dimension accuracy of work piece due to the heat generated at the first stage of automatic operation. After the power on, zero returning should be executed.

2. Warming up of spindle

CAUTION

If the machine is stopped for long time (more than 5 days), a sudden operation of the spindle may cut off of the oil film on the operating side of the spindle bearing , consequently, the spindle bearing may be pressed and stuck. Make sure to warm up the spindle.

8.15 Daily inspection items chart

1. Oil Quantity Confirm of the Hydraulic & Lubrication system

Inspection item		Checking method	Treatment
1	Hydraulic unit	Oil level gauge on the unit	1. Check for oil leaks at the joints 2. Replenish lubricant as required
	10ℓ		
2	Lubricating tank(4ℓ)	Oil level gauge Alarm display (LCD)	1. Check for oil leaks at the joints 2. Replenish lubricant as required 3. Replenish lubricant if the alarm is displayed.
3	Coolant tank	Oil level gauge	1. Replenish water or coolant according to the concentration
	400ℓ		

2. Pressure confirm of the hydraulic/lubrication system

Inspection item		Checking method	Treatment
1	Hydraulic unit	Pressure gauge on the hydraulic unit	40bar
2	Hydraulic chuck	Caution sticker of the machine front	~40bar (Depends on the type and usage of the chuck)
3	Lubrication systems	Pressure gauge on the unit	8~11 kgf/ cm ²

3. Others

Inspection item		Checking method	Treatment
1	Control unit alarm	Check the NC operation panel and LCD display.	Normal if nothing is displayed if an alarm is displayed. See the [alarm message] & FANUC-18iT manual
2	Operation of zero return	Check the zero position lamps. (X ₀ / Z ₀)	Return the X-and Z-axes to the zero positions after turning power on.
3	Operating conditions	Check for abnormal noise, vibration, door when starting operation.	If an abnormality is found, take corrective action immediately.

9. Periodic inspection

9.1 Inspection and maintenance

The periodic inspection by maintenance personnel is the key factor to maintain the machine accuracy for longtime. Proper treatment should be taken according to the operator's statement. And, contact our business office for the difficult points about the lathe drawing marks.

9.2 Confirmation items before the maintenance

- 1) The treatment should be taken after the contents of breakdown are heard from the personnel in charge of the machine on the site.
- 2) During the state examination, make a plan about the range of work and the work order.
- 3) Be well aware of the specification, structure and function of the place to be treated.
- 4) If the united work is needed, consult with the joint worker of the related department previously.
- 5) If exchange parts and supplies are needed, please prepare them previously

9.3 Cautions for the maintenance personnel

▲ WARNING

- 1) Electric maintenance should be executed by the designated responsible person of electric system maintenance.
- 2) Be sure to put on the proper clothes for the work.
- 3) While the maintenance is executed, put up a notice board which shows it's under the maintenance.
- 4) Make sure to cut off the power and turn off the main switch for the safe maintenance.
- 5) Do not touch or operate the electric wiring machinery switches with wet hands.
- 6) Do not change the set up values of each machinery or parameter without permission.
- 7) Tools should be proper to the place in which they are used.
- 8) Do not lay the tools or parts directly on the operating side.
- 9) For the work at a high position, use a ladder or a work bench.
- 10) For handling heavy things, more than 2 people should be engaged in, or crane should be used for the work.
- 11) The rope or crane should be correspondent to the weight.
- 12) When the united work is carried out, be sure to give a sign and confirm it from the other person.
- 13) Be sure to use the designated electric machinery for exchange.
- 14) The worker should enter the machine to do the work, make sure to cut off the power and turn off the main switch.

9.4 List of periodic inspection items

		Item	Check	Periodical check			After 1st. year		Reference values
				3 month	6 month	12 month	6 month	12 month	
Base	1	Leveling bolt	Lower base	○	○	○		○	
Spindle drive system	2	Spindle starting torque	Head stock	○		○		○	
	3	Belt tension	Spindle motor ↔ Spindle	○	○	○		○	
	4	Clamping bolts	Head stock		○	○		○	
			Motor and motor base		○	○		○	
Axis drive system	5	Back lash	X-axis/Turret OD		○	○		○	
			Z-axis Turret end face		○	○		○	
	6	Sliding surface wedge (Slide plate clamping)	Saddle wedge		○	○		○	
			Cross wedge		○	○		○	
	7	Cleanliness of sliding	For saddle		○	○		○	
			For cross		○	○		○	
	8	Ball screw starting torque	X-axis ball screw		○	○	○		
			Z-axis ball screw		○	○	○		
	9	Timing belt tension	Head stock rear end surface		○	○	○	○	

9.5 Confirmation and adjustment of gib

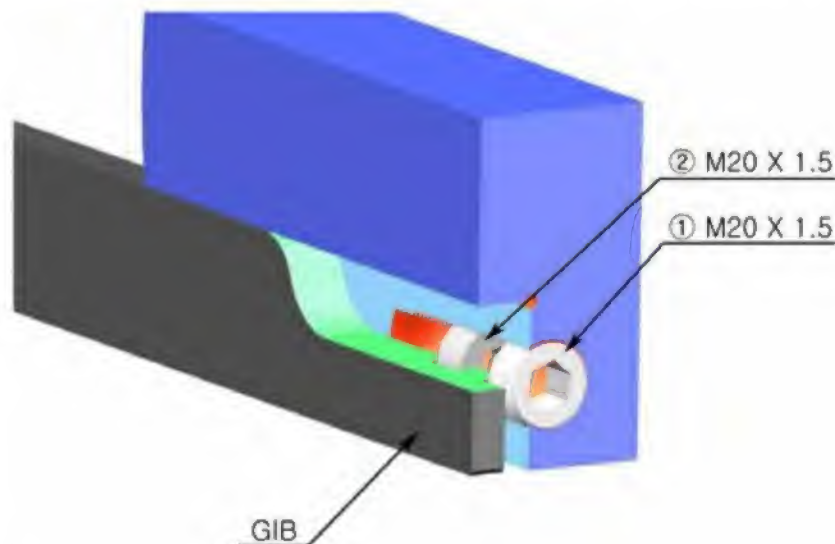
There is gib at each operating side, which is already adjusted by our company, therefore, adjustment is not needed. However, if the machine is operated for long period, the gib might be worn or loose, which results in instable feed state. If it influences the processing accuracy, adjust the gib.

< Inspection period >

2,000 hours of operation

< Adjustment >

For the adjustment, Remove the L/R-side cover and back cover. Then some gibs with adjusting bolts will be seen. For the others gibs, dismantle the slide wipers on the saddle and toolpost. The gib is inserted from the front direction indicated in the figure. Adjustment should be done with the adjusting screw (M20xP1.5). Work should be carefully done.



< Procedure >

- 1) Loosen the adjusting screw ①.
- 2) Loosen the adjusting screw ②. At this time, the gib is disassembled together.
- 3) Take out the gib and confirm the contact state or oil supplying state.
- 4) After cleaning the gib, reassemble the gib by the adjusting screw ②.

Fasten them with the clamp torque 2.4kgf•cm and loosen it again for the quarter the revolution. (Securing the gap of 0.01 – 0.015)

- 5) Clamp the adjusting screw ①.
- 6) Loosen the adjusting screw ② to fix the gib with the adjusting screw ①.

⚠ CAUTION

Confirm the current value of the servo motor not to push the gib in excessively. Confirm the positioning accuracy of the each axis repeatedly. After the adjustment, increase the feed including handle feed, jog, feed and rapid traverse in order.

9.6 Confirmation and adjustment of backlash

There can be the difference between the commanded value and the actual moving quantity of X/Z axes in NC. This is caused by the chink at the feed part followed by the servo motor.

- 1) Backlash of bearing
- 2) Backlash of ball screw
- 3) Backlash of the coupling and gear connecting the servo motor and the ball screw.
- 4) Overall backlash of the machine is generated as the chink of gib at the operating side is accumulated. Some degree of backlash is necessary depending on the kind of machine.

Too little backlash may reduce the life span of bearing, belt and gear or may cause noise and vibration. Backlash compensation function is prepared in the NC for electrical correction of the errors generated by the backlash of operating part. At the moment that machine is delivered, the quantity of backlash compensation is optimally set already. However, if it is not proper because of the long term use, reset it.

< Parameter NO. >

X-axis 1850

Y-axis 1851

< Measuring procedure of backlash >

- 1) Install the dial gauge (1/100mm) at the place free from vibration using a magnet stand.

OBSERVANCE

Be sure that the dial gauge always contacts with the same position of the turret head.

- 2) Set the mode selection switch to "MANUAL".
- 3) Set the handle switch to "X10".
- 4) Move the tool post 50mm from the plus direction of X axis to its minus direction turning the handle of the and set the scale of dial gauge to "0".
- 5) Set the relative coordinates U and W to the present position to "0".
- 6) Move Z axis about 100mm to the plus direction.

OBSERVANCE

Move it to the position that the dial gauge is moved from the turret head, that is the position set up as the position of U0 and W0

- 7) Move X axis about 50mm to the minus direction.
- 8) Move X axis again to the relative coordinate of U0.

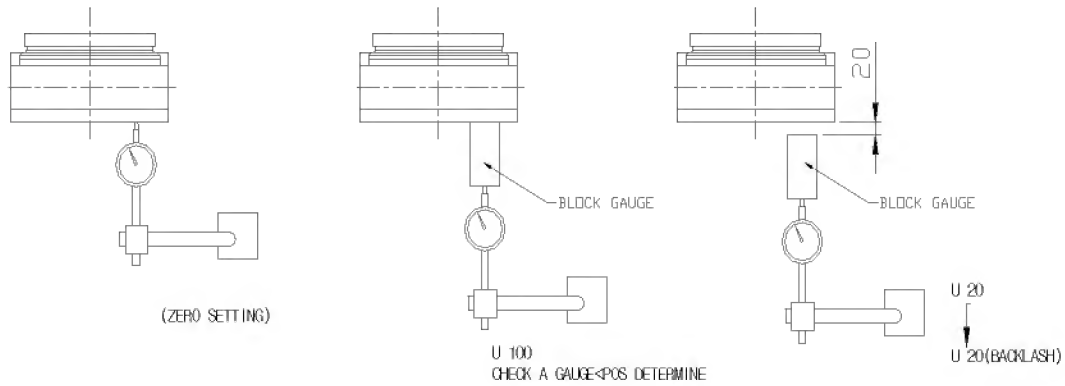
CAUTION

At this time, the positioning should be done only for the plus direction of X axis

- 9) Move Z axis to the minus direction of W0..

At this time, read the scale of the dial. This position is the composite backlash.

Include this position into the quantity of backlash compensation.

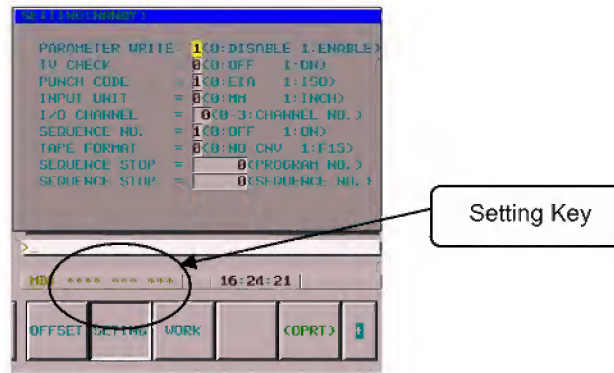


OBSERVANCE

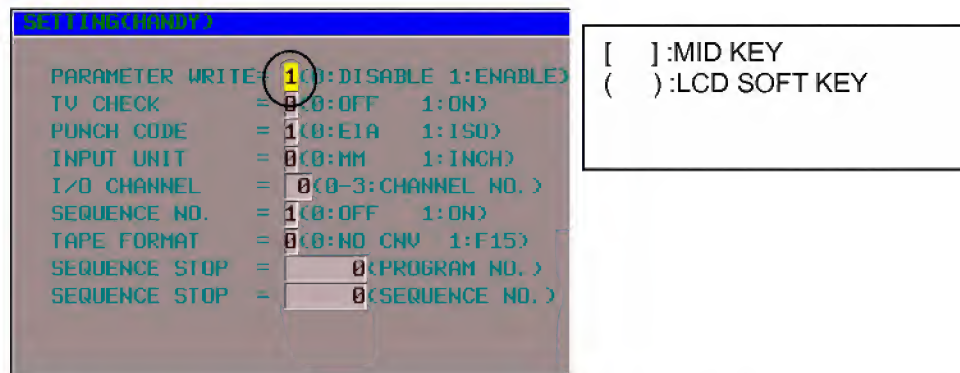
- 1) With the dial gauge contacted with the turret head, set the scale of dial gauge to "0".
- 2) Move the pulse generator 1 pulse to the minus direction of X axis at the handle switch [X10], 1 pulse to X axis plus direction once more and set the scale of dial gauge to "0". And when it is moved 2 pulse to the plus direction, set up the quantity of backlash compensation to make the scale of the dial gauge "0". Therefore, a bit lower value than the measured quantity of backlash should be set. Otherwise, during circular arc cutting
- 3) When the moving direction is changed from the plus direction of X-axis (Z-axis) to the minus direction, there may be lines or stages appeared at the peak. The same procedure is applied for X-axis.
- 4) Measurement should be done at the automatic RAPID.

9.7 The Setting Method for Parameters

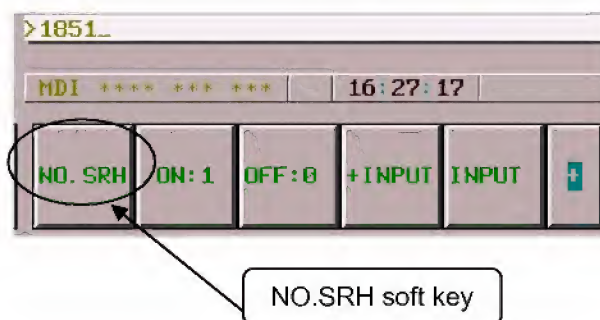
- 1) Select the mode switch to "MDI mode"
- 2) Press [OFFSET] Key
- 3) Press the soft key (Setting) on the bottom of monitor.



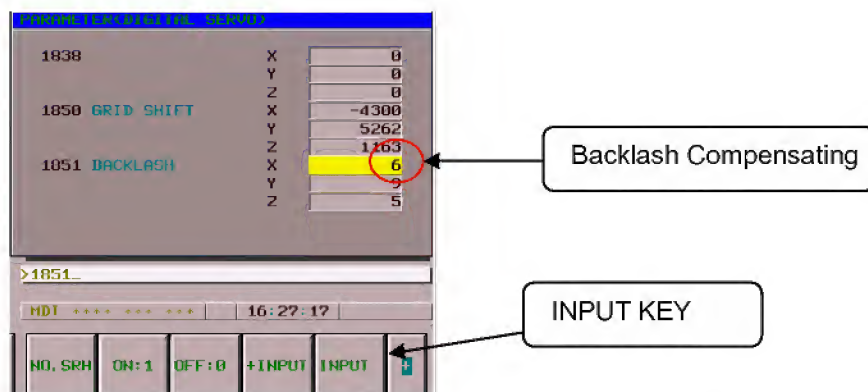
- 4) Input "1" to "Parameter Write="
- 5) In this case, there is an alarm message such as "100 PARAMETER WRITE ENABLE".



- 6) In order to reset the status of alarm #100, select the both key [Can] and [Reset] simultaneously.
- 7) Press [System] key.
- 8) Input the related number by using Numeric key, then press the (NO.SRH) soft key on the bottom of monitor.
 - 1850 : Backlash compensating value for cutting feed for X,Y,Z-axis(FANUC 0i /21i /18i)
 - 1851 : Backlash compensating value for rapid traverse for X,Y,Z-axis(FANUC 0i /21i /18i)



- 9) Press [INPUT] key after the value of backlash compensating is input by using Numeric key.



- 10) Finally, check the setting value of parameters is correct, disable "the parameter write=" to "0" on the Setting screen.

9.8 Inspection and Exchange of slide wiper

< Inspection Period >

1,000 hours of operation

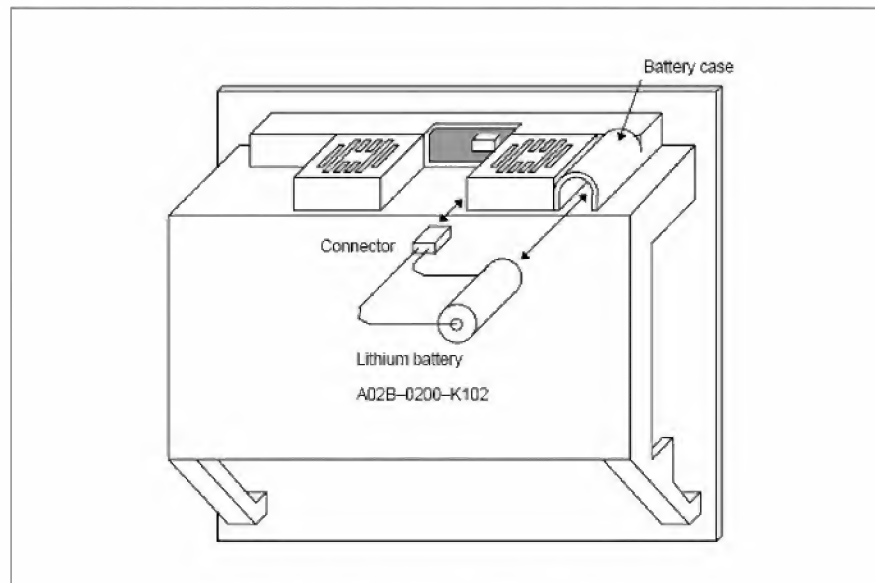
Slide wiper prevents the cut chips from invading the operating side(slide surface) and maintain the uniform oil film. The slide wiper is installed on each operating side(slide surface). Slide wiper needs the periodic inspection. Carefully examine that there is a crack generated by the friction at the contact part of slide wiper or the cut chips. When the matter of slide wiper is found, quickly exchange it.

9.9 Replacing Batteries

1) Consideration

- 1) Replace the battery in the control power on
- 2) Battery specification: FANUC A02B-0200-K102
- 3) Replace the battery when [BAT] alarm appears on the screen (LCD, CRT)

2) Replacing battery of system Back-up



STAND – ALONE TYPE I SERIES

- 1) Lithium battery (Order number is *A02B-0200-K102) is required.
- 2) Turn on the power to the CNC for about 5 minutes.
- 3) Turn off the power to the entire machine.
- 4) Referring to the manual provided by the machine tool builder, open the cabinet in which the CNC controller is mounted.
- 5) The battery used for memory back up is located on the front of the main board.
- 6) Remove the battery cover on the main board by holding the upper and lower part of the battery cover and pulling it towards you. Then take off the battery.
- 7) Remove the connector (CP8) on the main board towards you.
- 8) Connect the connector of new battery to main board.
- 9) Mount a battery and put the battery cover back on.
- 10) Turn on the power to the machine (CNC) to check that no alarm appears on the screen of display unit

SECTION B

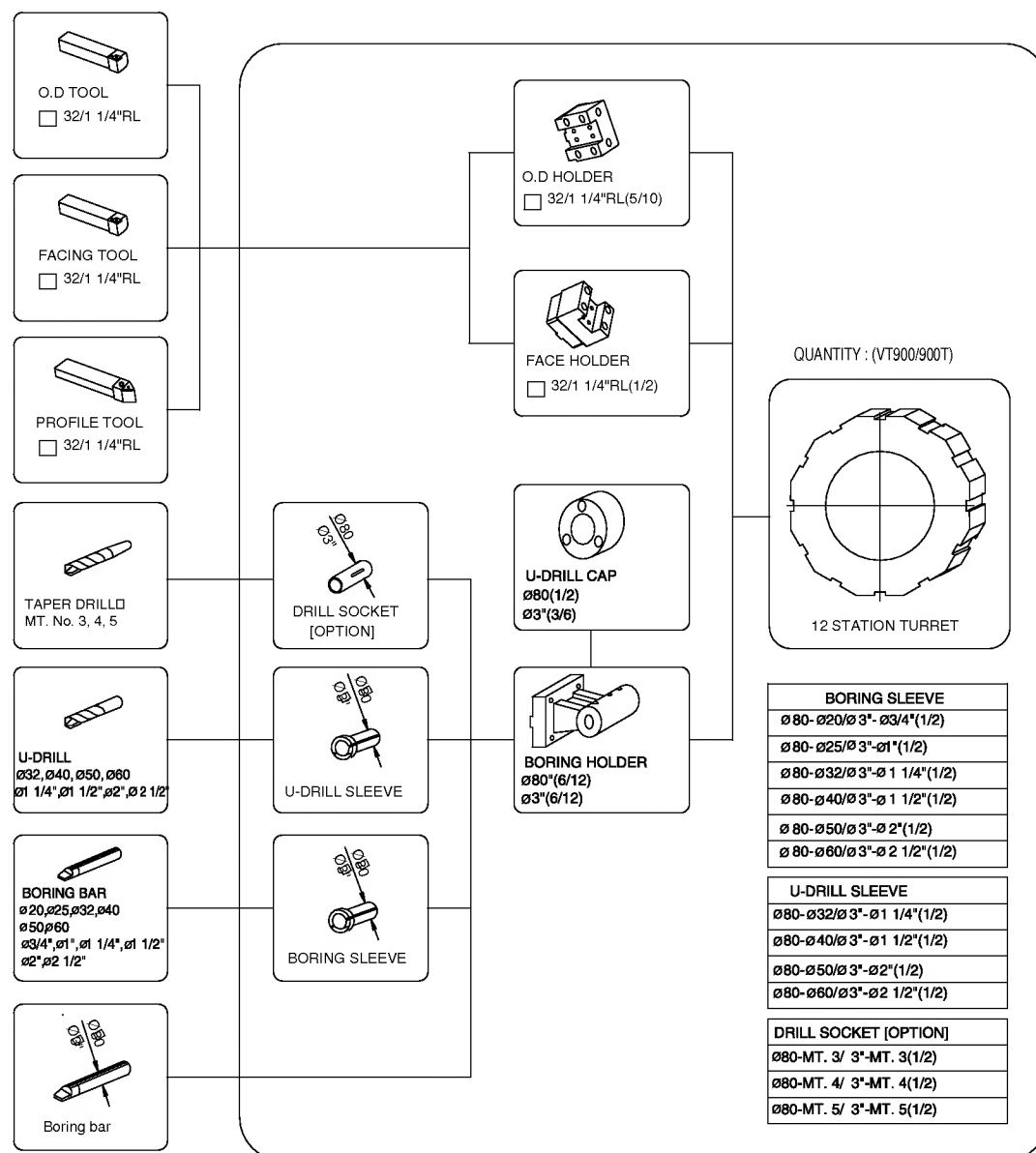
TOOLING

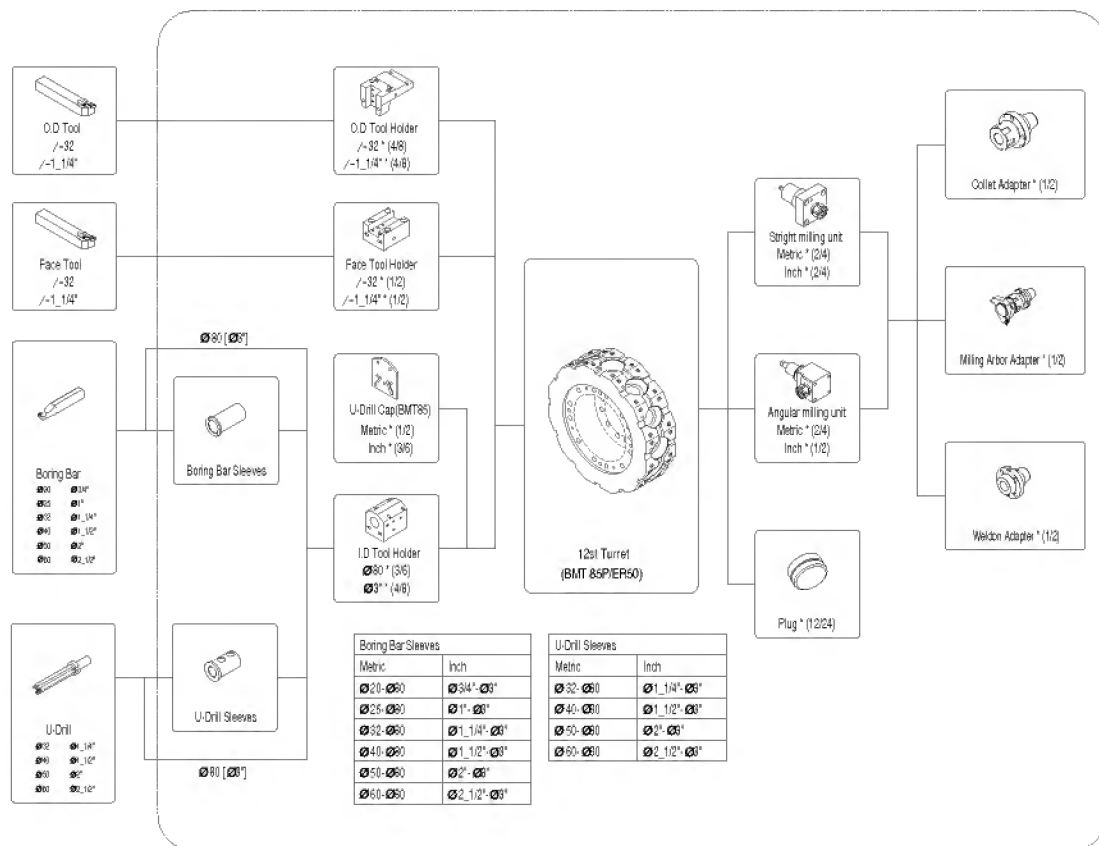
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1. Tooling system

1.1 PUMA VT900

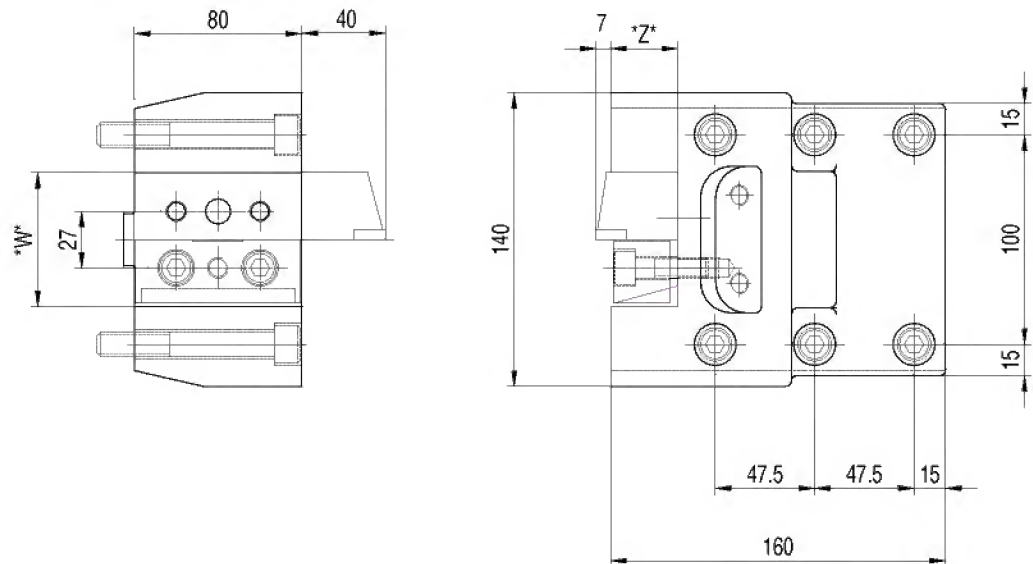




2. Tool Holder Dimensions

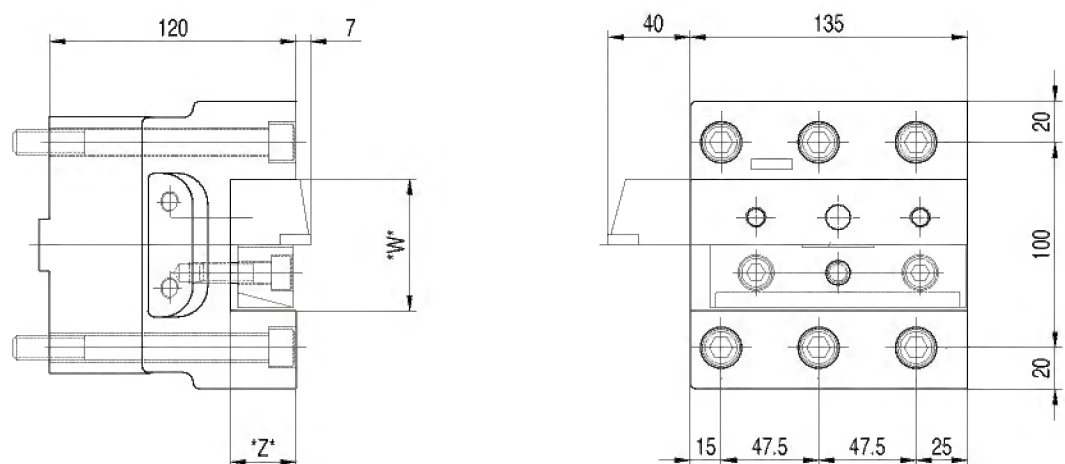
2.1 PUMA VT900/VT900-2SP

(1) OD Tool Holder(32mm/1.25")



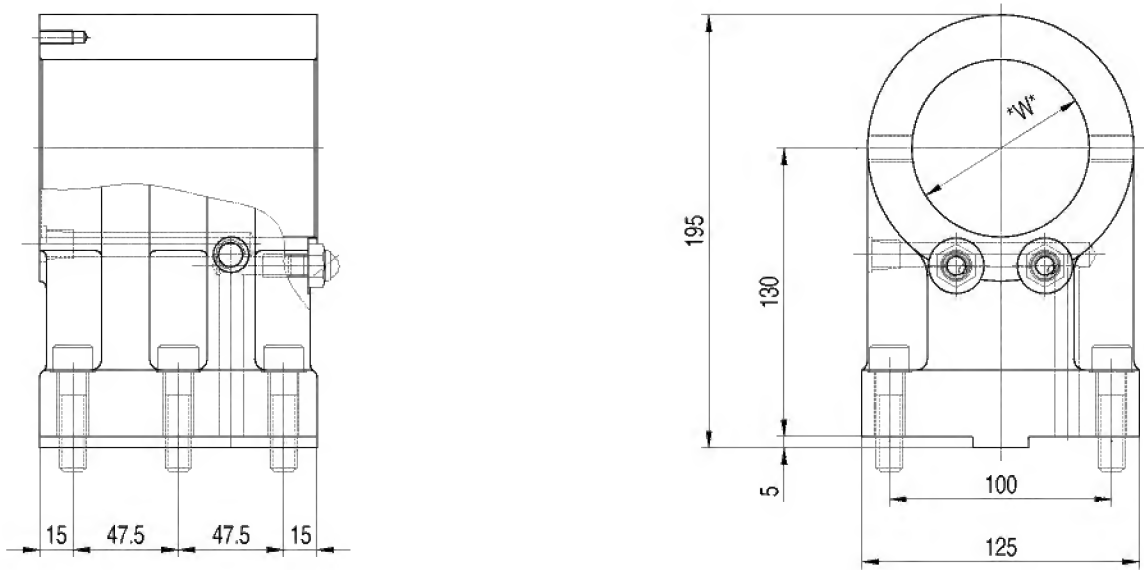
REF.NO	*W*	*Z*	REMARKS
LVVM108	64.0 ^{+0.05}	32	METRIC
LVVM205	63.5 ^{+0.05}	31.75	INCH

(2) Face Tool Holder(32mm/1.25")



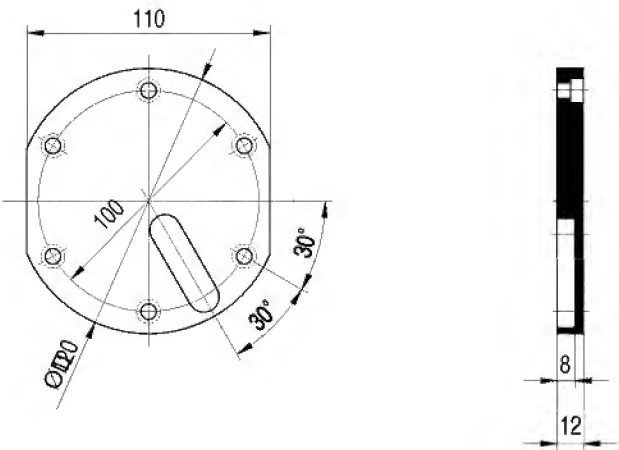
REF.NO	*W*	*Z*	REMARKS
LVVM106	64.0 ^{+0.05}	32	METRIC
LVVM206	63.5 ^{+0.05}	31.75	INCH

(3) ID Tool Holder(80mm/3")

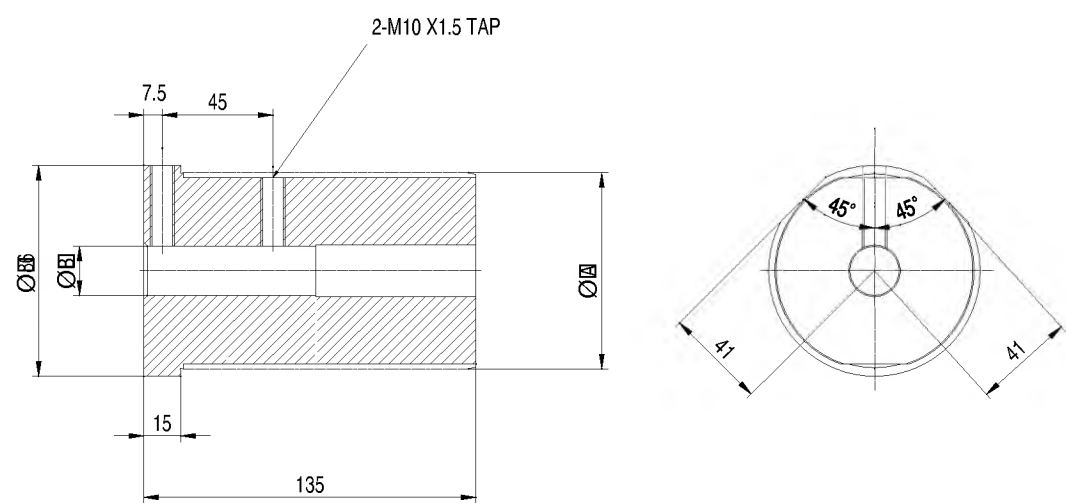


REF.NO	*W*	REMARKS
LVVM133	$\varnothing 80.0H7^{+0.030}_0$	METRIC
LVVM233	$\varnothing 3.15H7^{+0.030}_0$	INCH

(4) U-Drill Cap(80mm/3")

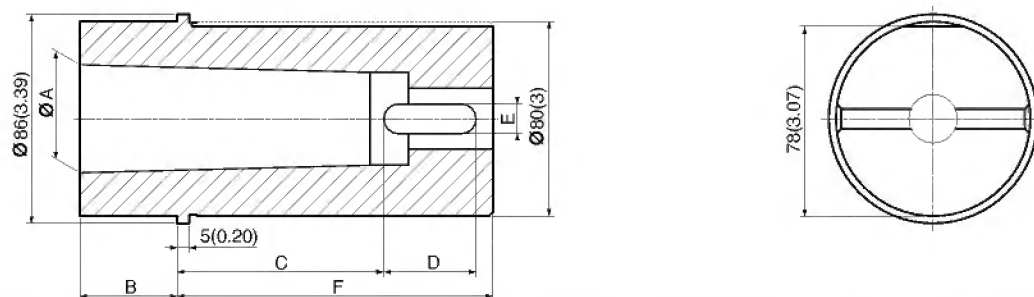


(5) Boring bar sleeve (Ø80mm/3")



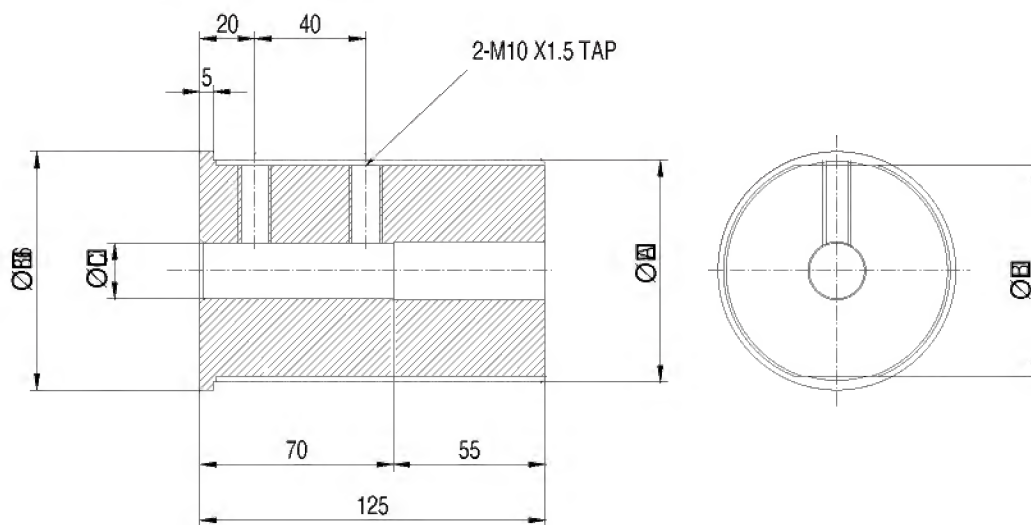
$\varnothing A$	$\varnothing B$
$\varnothing 80$	10
	12
	16
	20
	25
	32
	40
$\varnothing 76.2$	9.525
	12.700
	15.875
	19.050
	25.400
	31.750
	38.100

(6) Drill socket(Ø80mm/3")



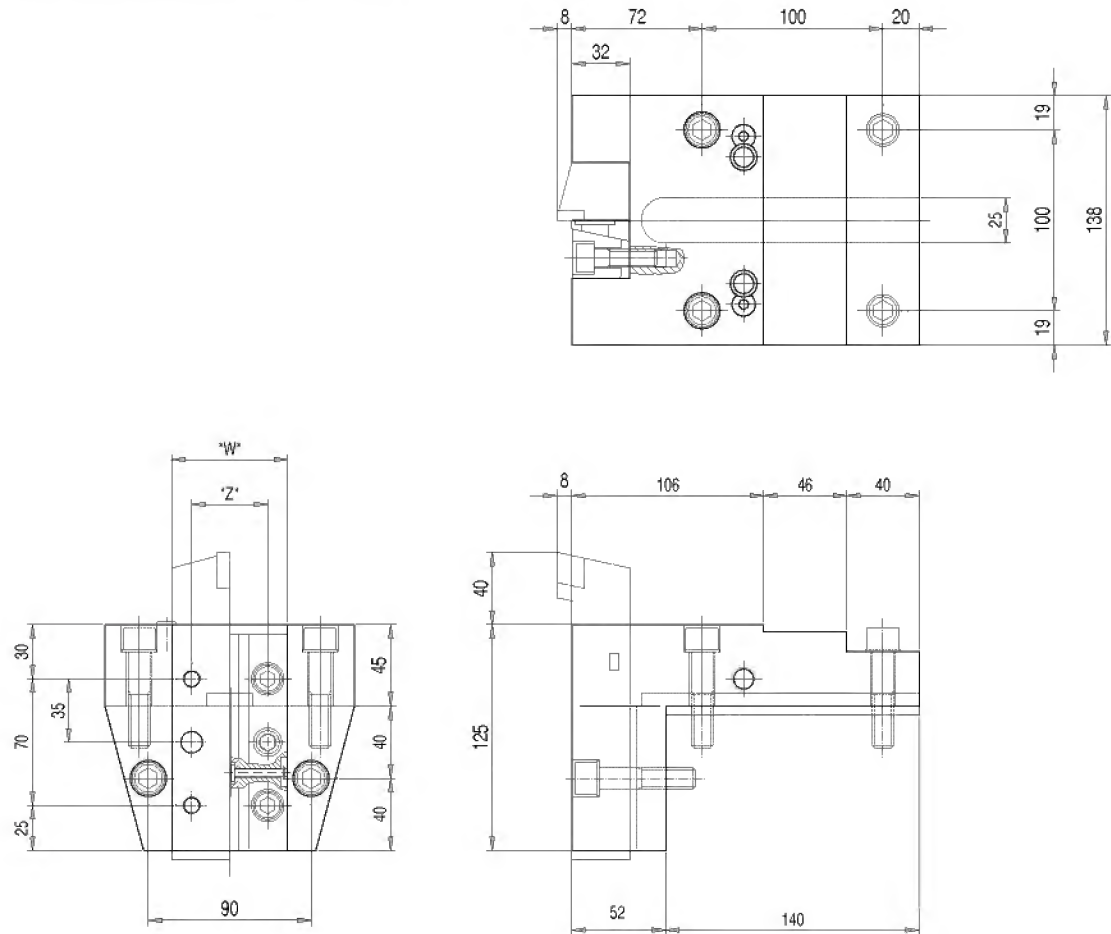
	Ø A	B	C	D	E	F
MT NO.2-D60	17.780(0.70)	-	62(2.44)	22(0.87)	6.6(0.26)	125(4.92)
MT NO.3-D60	23.825(0.94)	-	78(3.07)	27(1.06)	8.2(0.32)	125(4.92)
MT NO.4-D60	31.267(1.23)	5(0.20)	93(3.66)	32(1.26)	12.2(0.48)	130(5.12)
MT NO.5-D60	44.399(1.75)	40(1.54)	85(3.35)	38(1.50)	16.2(0.64)	130(5.12)

(7) U-Drill sleeves (Ø 80mm/3")



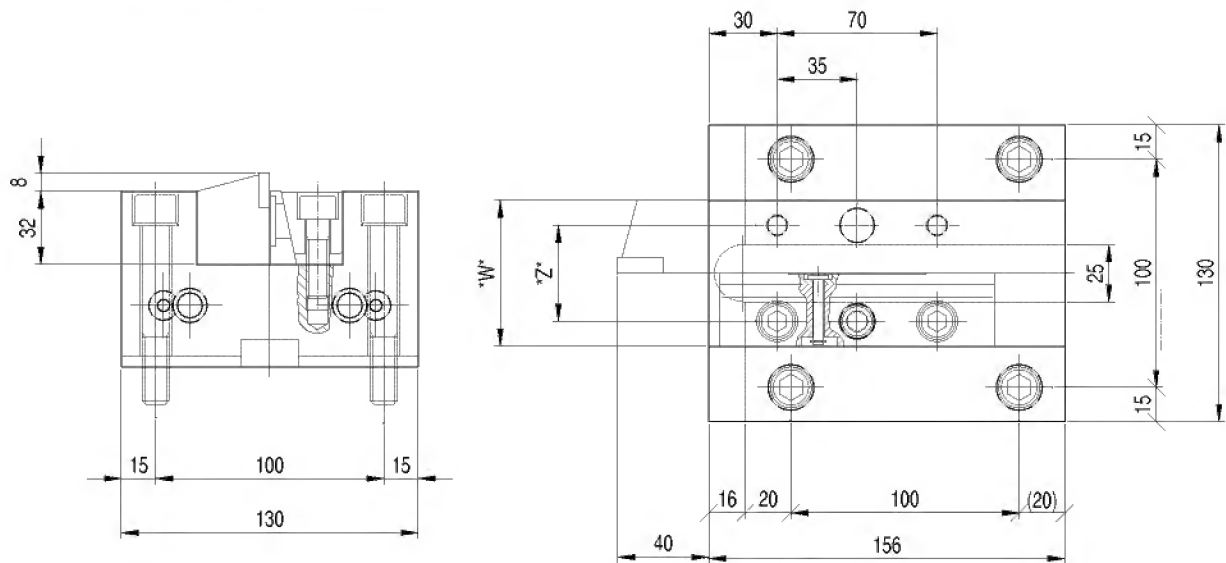
ØA	ØB	ØC
Ø80	76	20
		25
		32
		40
Ø76.2	74	19.050
		25.400
		31.750
		38.100

2.2 PUMA VT900M/VT900M-2SP
(1) OD Tool Holder (32mm/1.25")



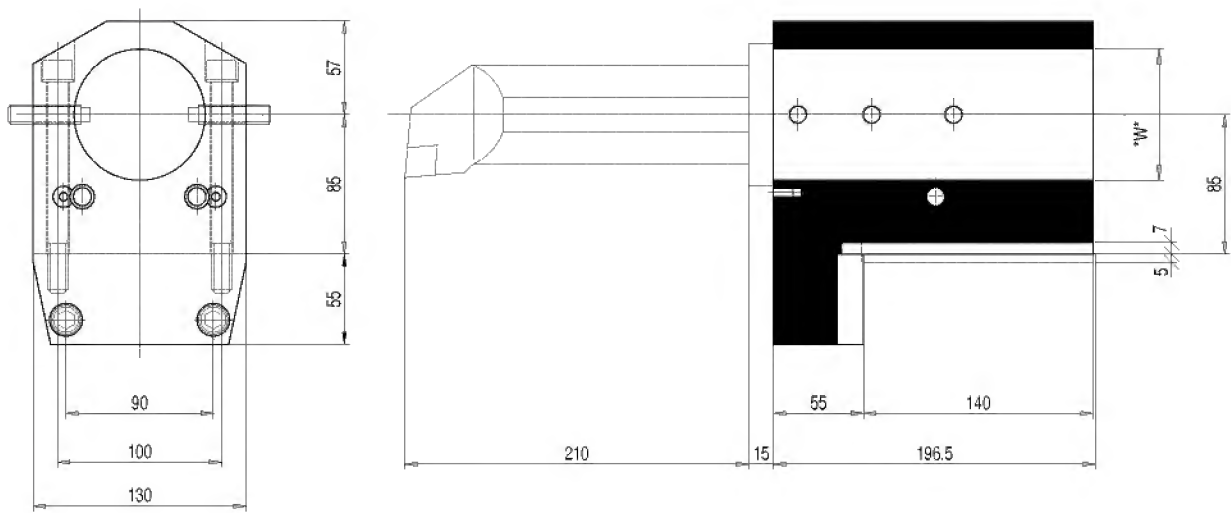
REF.NO	"W"	"Z"	REMARKS
L70555313F	64.0 ^{+0.02}	42.0	METRIC
L70556313F	63.5 ^{+0.02}	41.75	INCH

(2) Face tool holder(32mm/1.25")



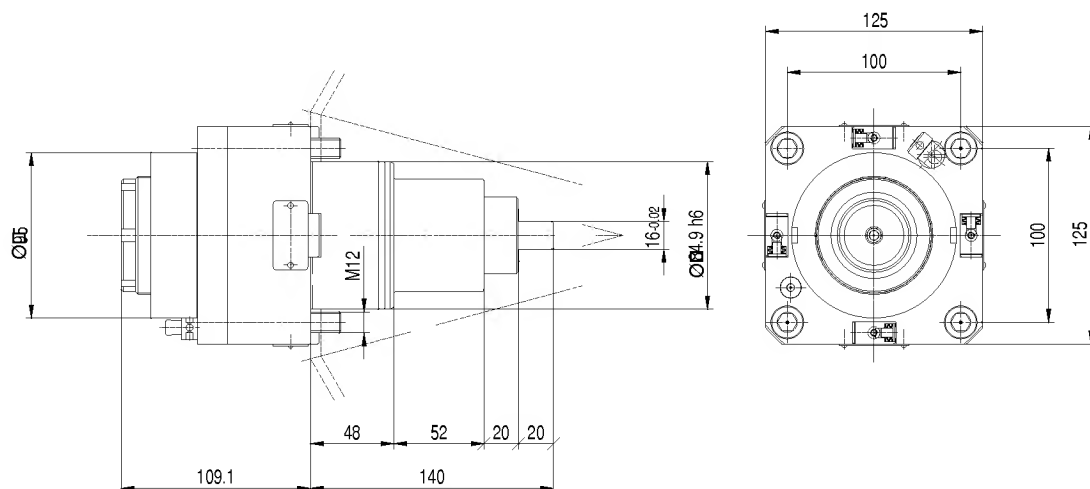
REF.NO	*W*	*Z*	REMARKS
L70555313F	64.0 ^{+0.02}	42.0	METRIC
L70556313F	63.5 ^{+0.02}	41.75	INCH

(3) ID tool holder(80mm/3")

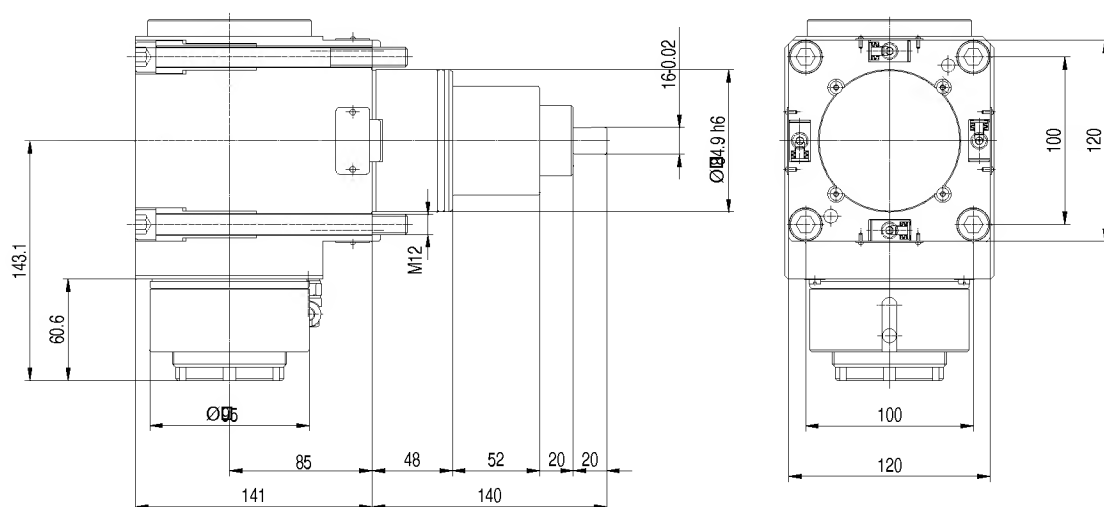


REF.NO	*W*	REMARKS
L70555123H	Ø60.0H7 ^{+0.030} ₀	METRIC
L70556123H	Ø6.2H7 ^{+0.030} ₀	INCH

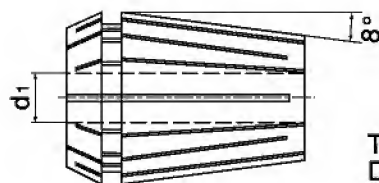
(4) Straight Milling Unit



(5) Angular Milling Unit



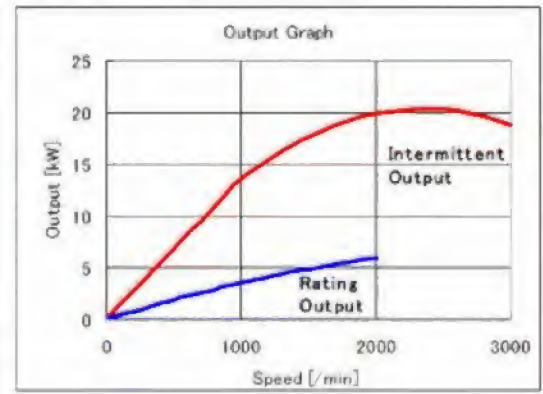
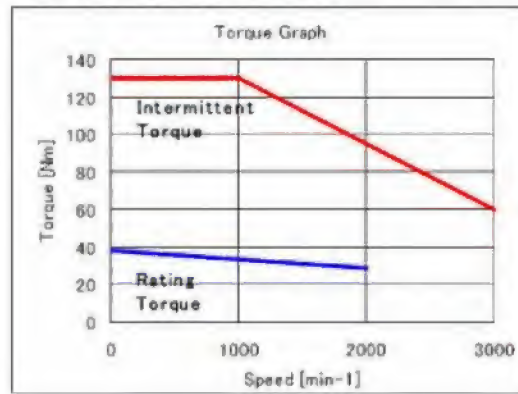
(6) Milling Collets



Type RD/ER
DIN 6499

Type ER50		
ER50(Ø6~Ø34, 14pcs)		ER50(Ø3/8~Ø1-3/8, 15pcs)
Size(mm)	Clamping range	Size(inch)
6	6~8	-
8	8~10	-
10	10~12	3/8"
12	12~14	7/16"
14	14~16	1/2"
16	11~18	9/16"
18	18~20	5/8"
20	20~22	-
22	22~24	3/4"
25	25~27	-
27	27~29	7/8"
28	-	-
30	-	1"
32	32~34	1-1/4"
34		1-3/8"

3. Rotary Tool Speed-Torque diagrams (PUMA VT900M/VT900M-2SP)

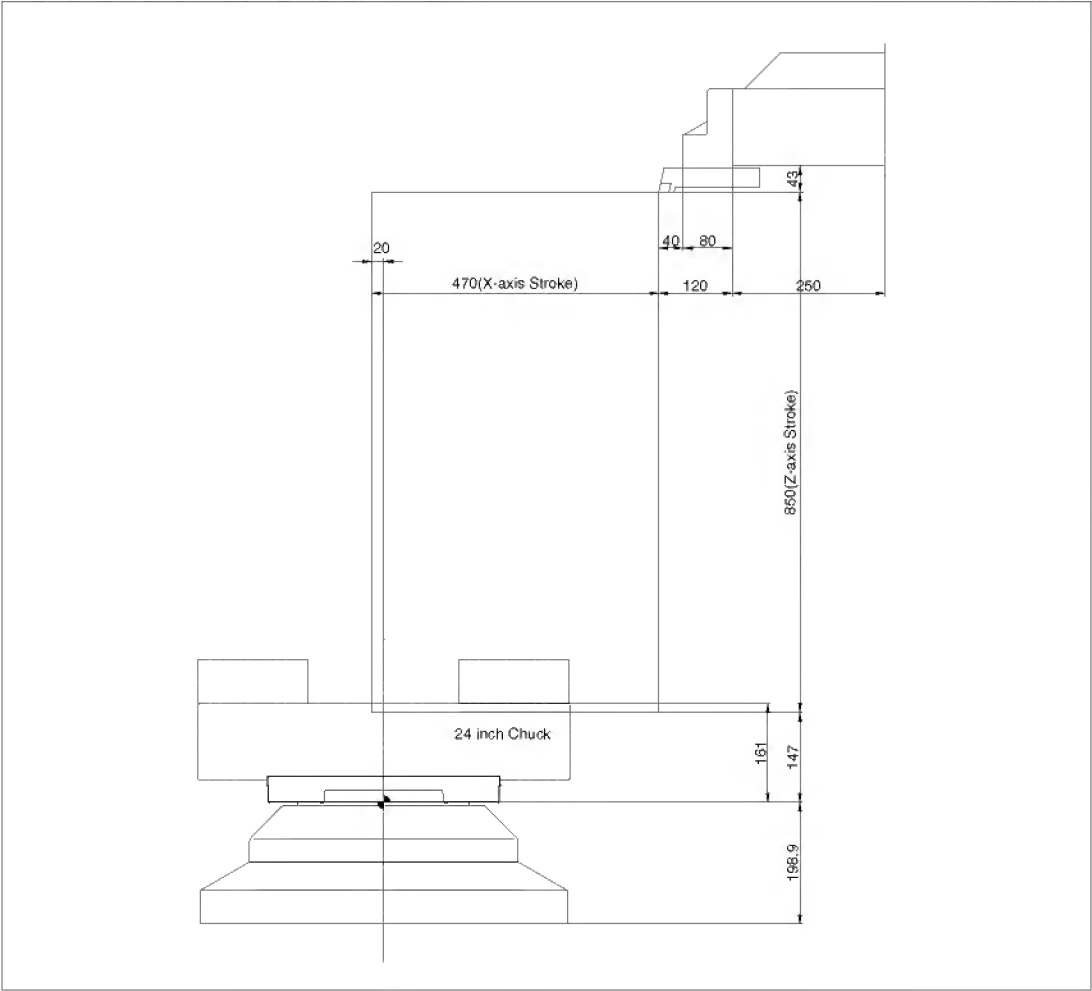
Servo Motor $\alpha i F$ 40/3000

4. Working Range Diagram

4.1 PUMA VT900/VT900-2SP

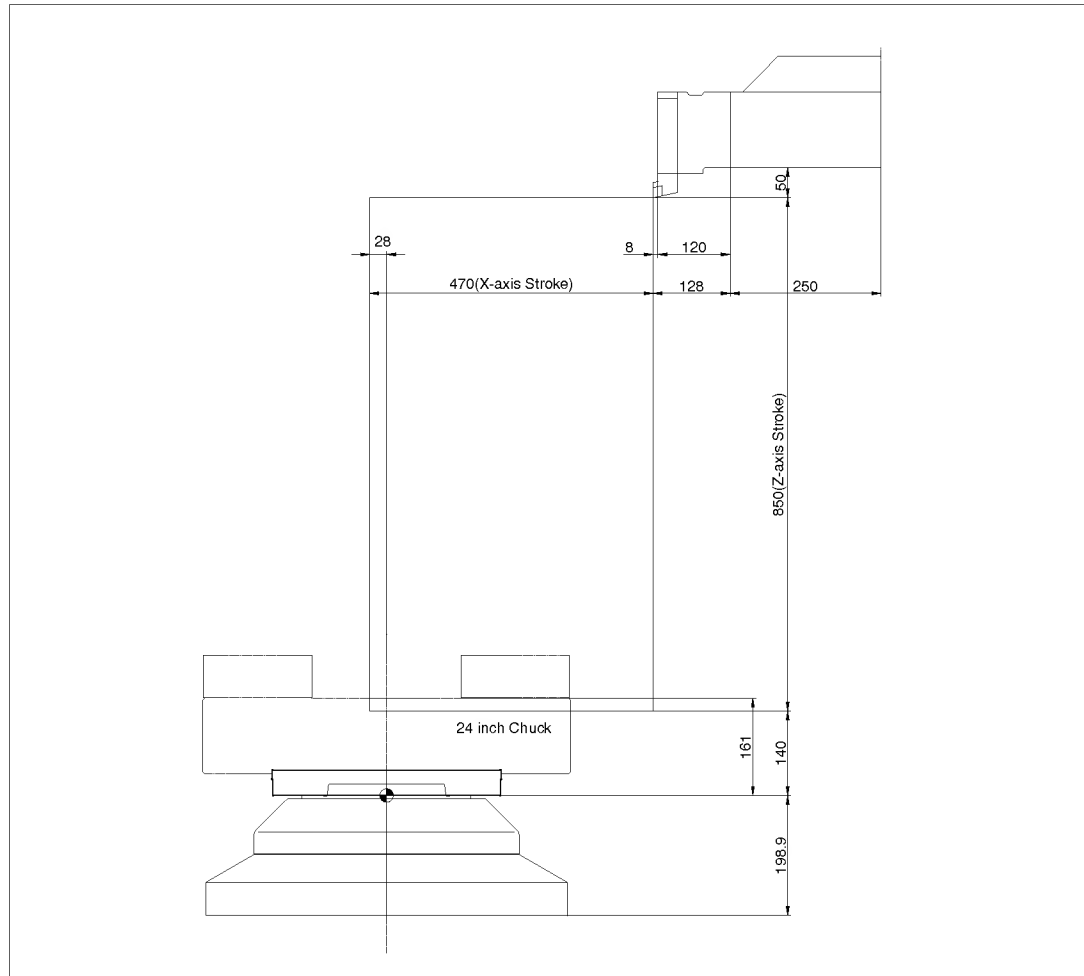
(1) OD Tool Holder Range

Unit: mm



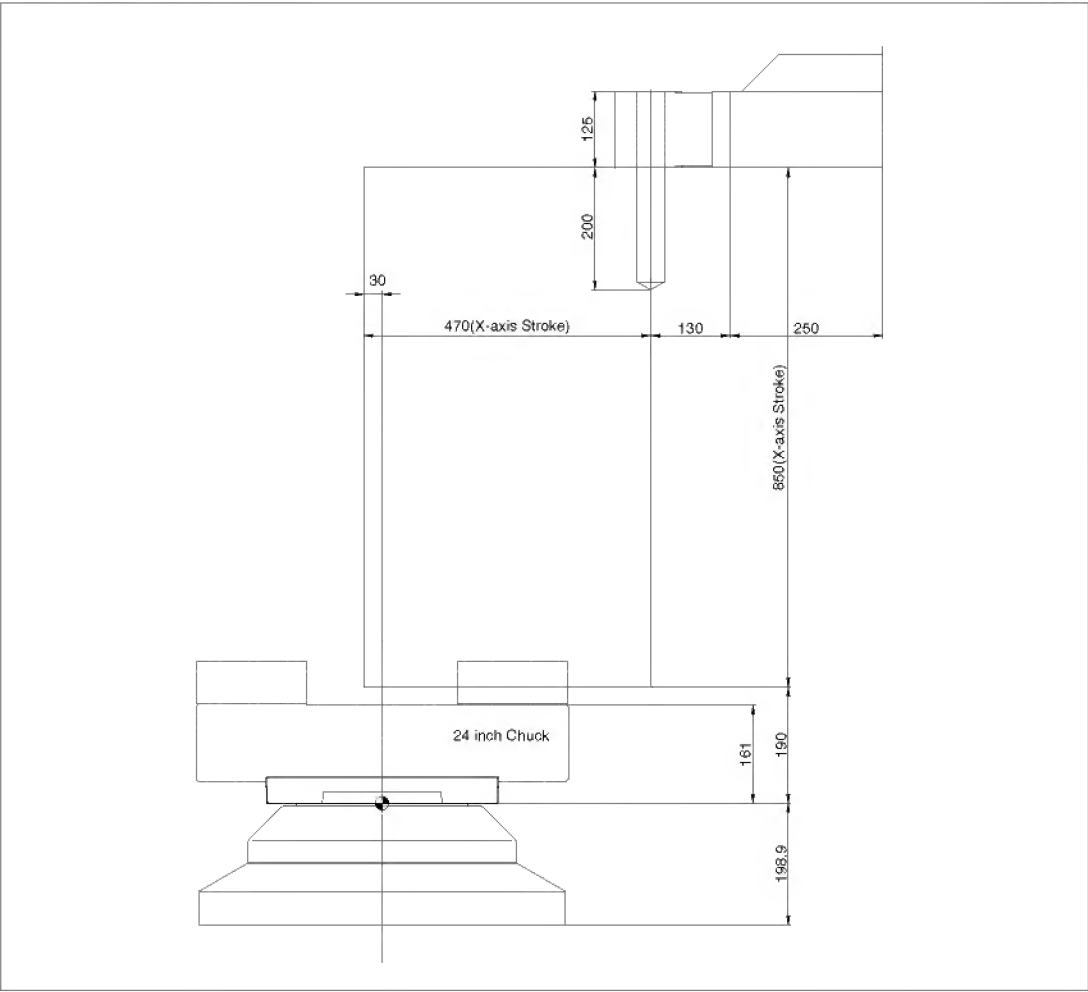
(2) Face Tool Holder Range

Unit: mm



(3) ID Tool Holder Range

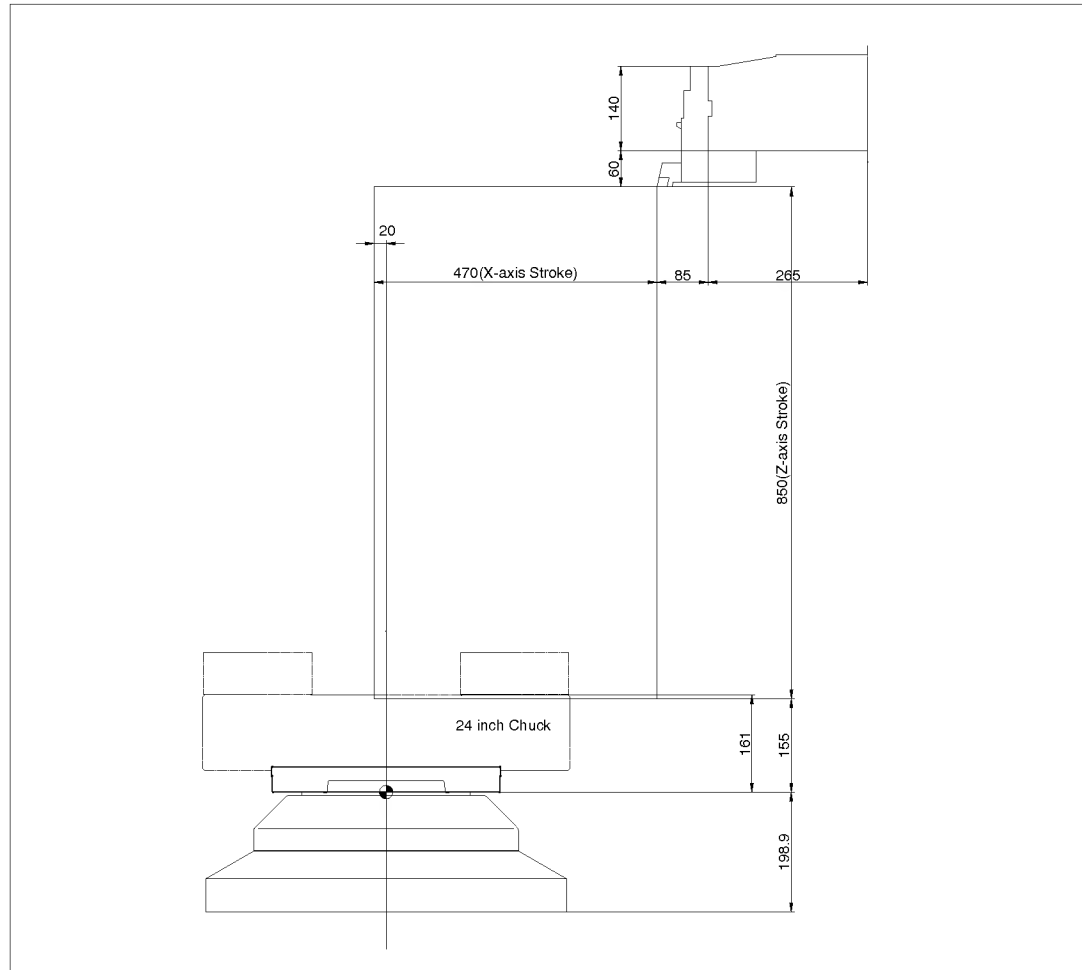
Unit: mm



4.2 PUMA VT900M/VT900M-2SP

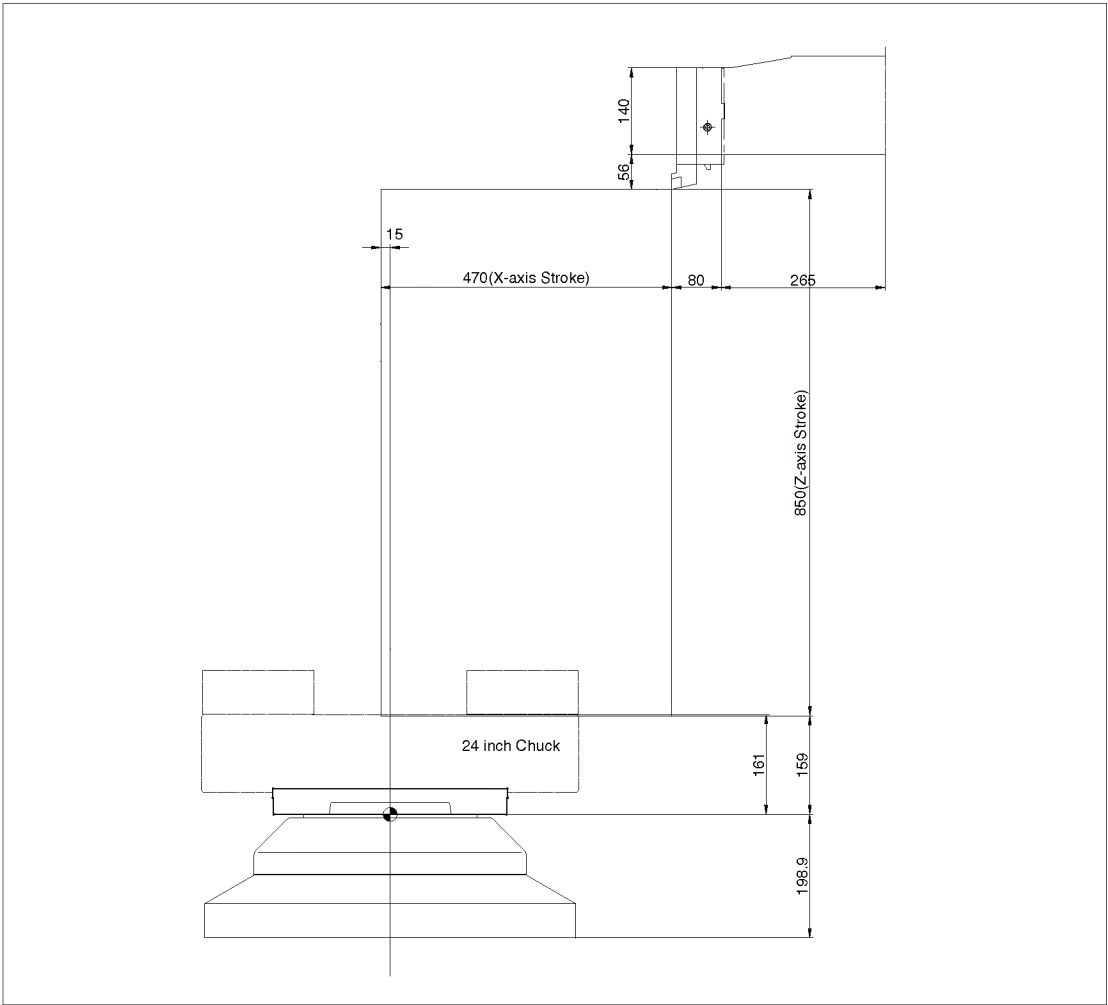
(1) OD Tool Holder Range

Unit: mm



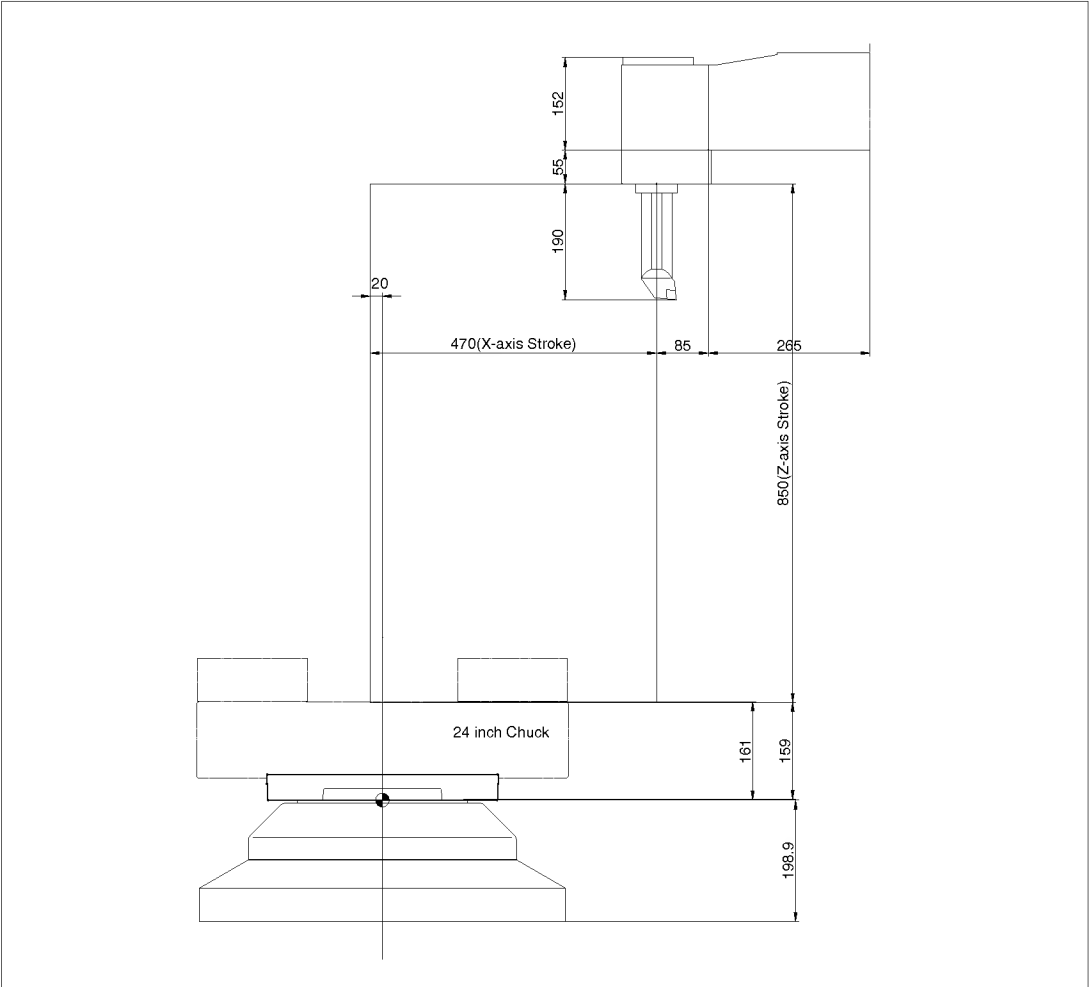
(2) Face Tool Holder Range

Unit: mm



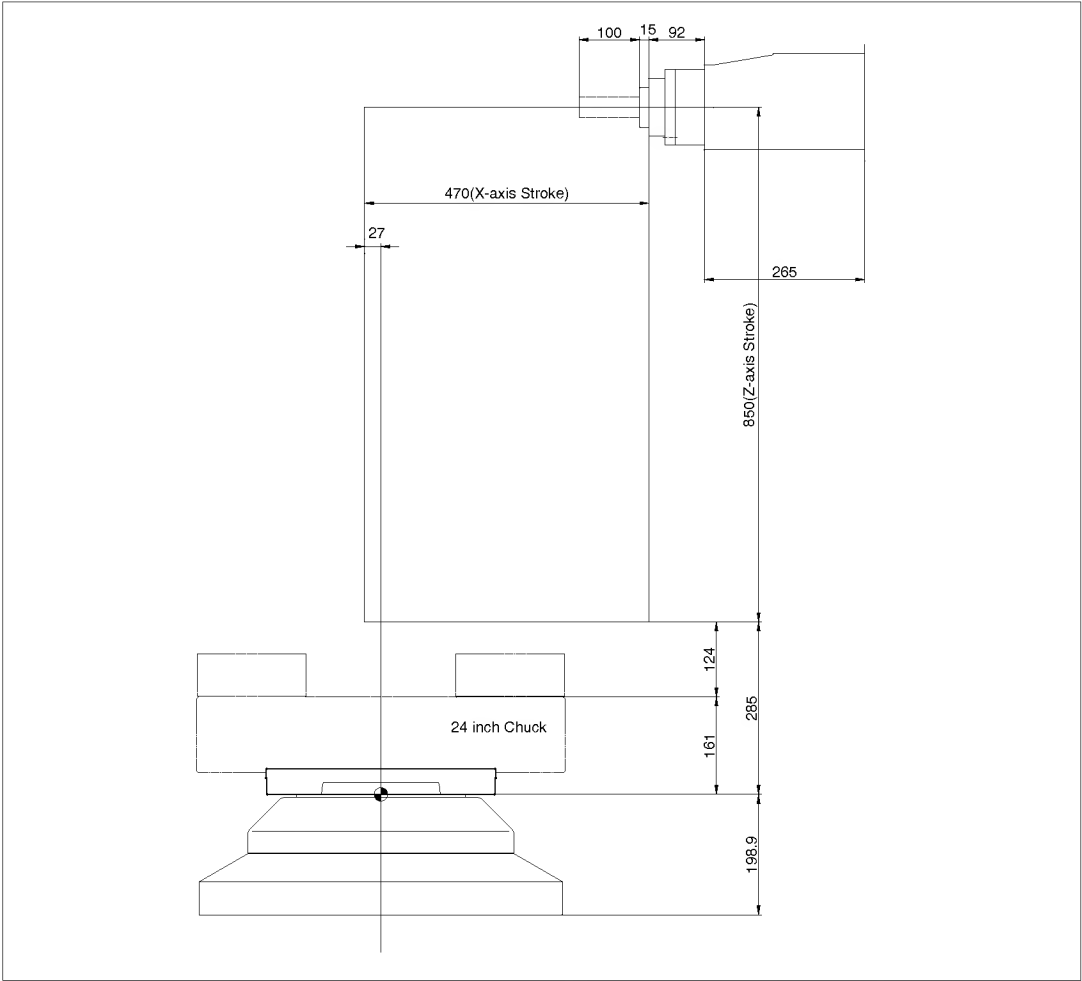
(3) ID Tool Holder Range

Unit: mm



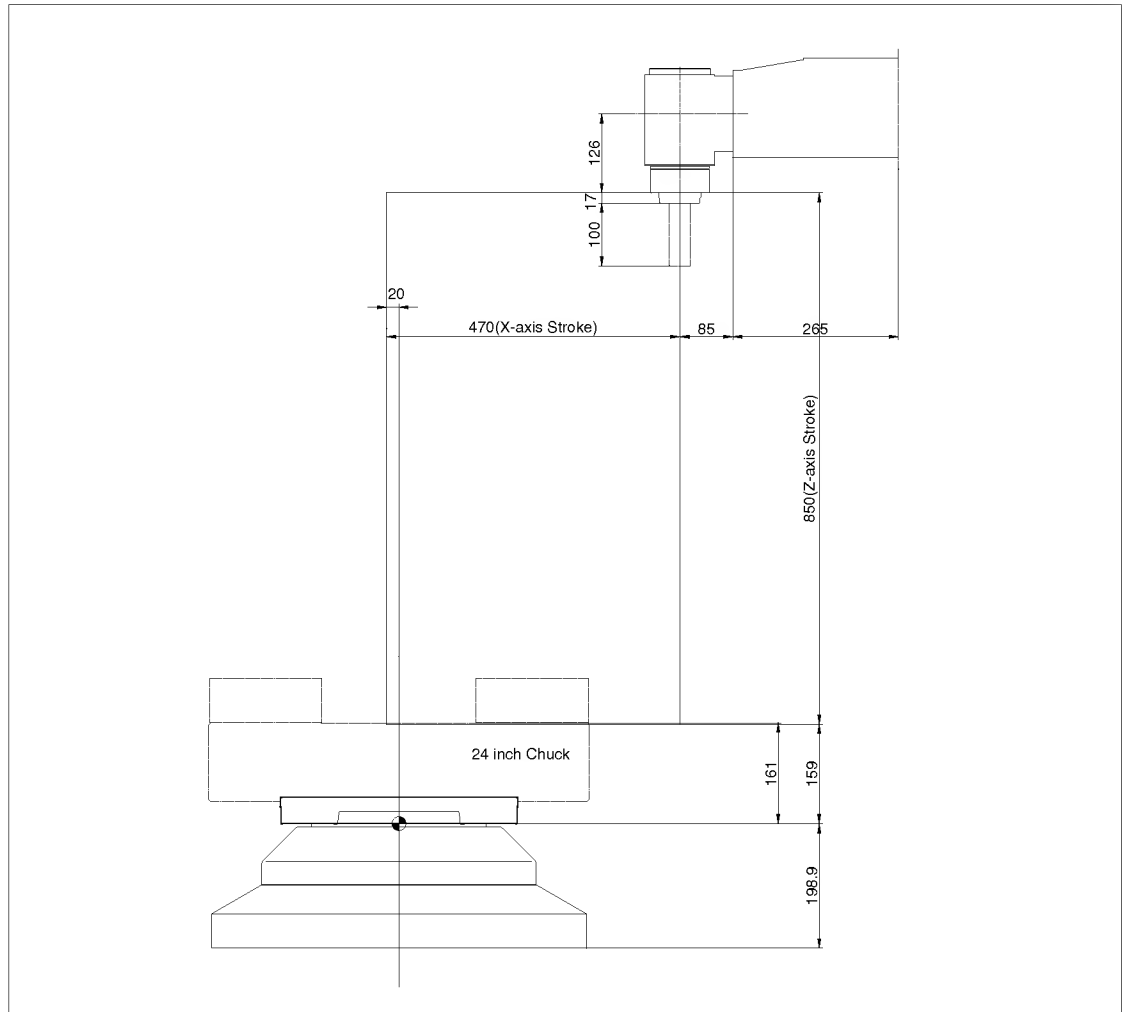
(4) Straight Milling Tool Holder Range

Unit: mm



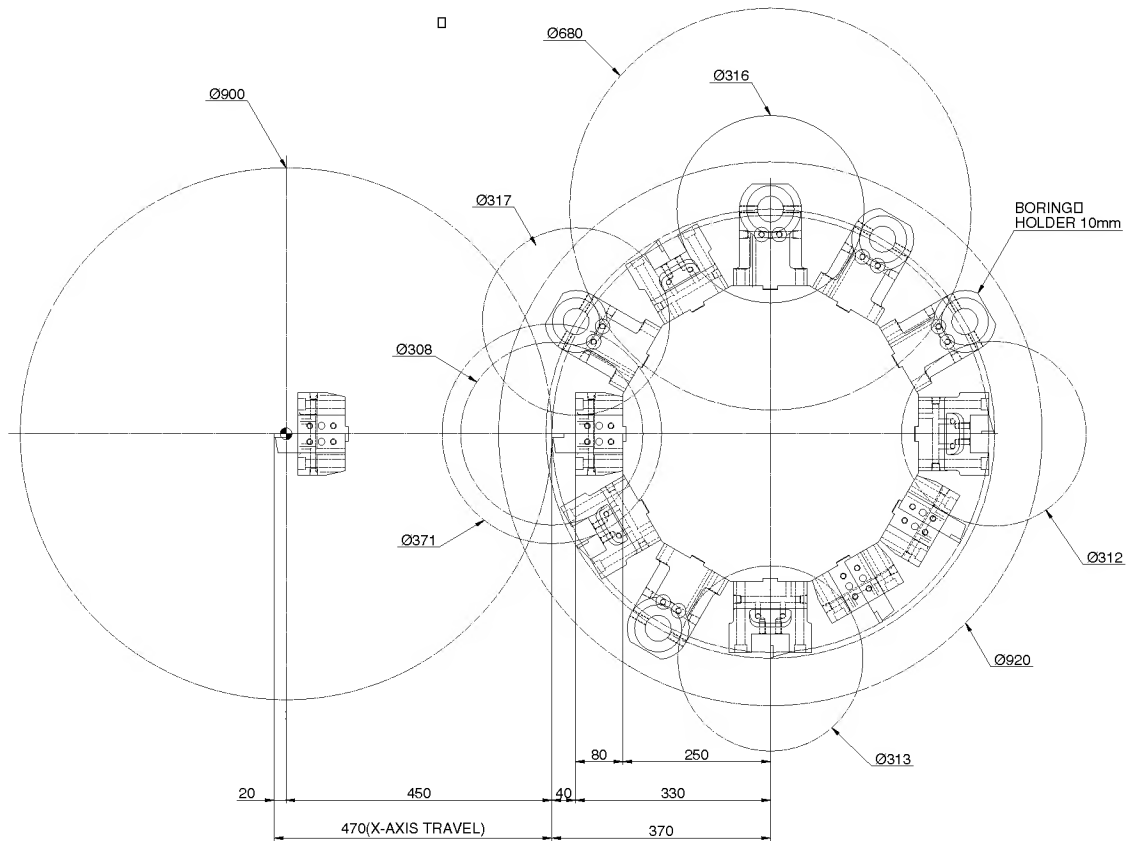
(5) Angular Tool Holder Range

Unit: mm

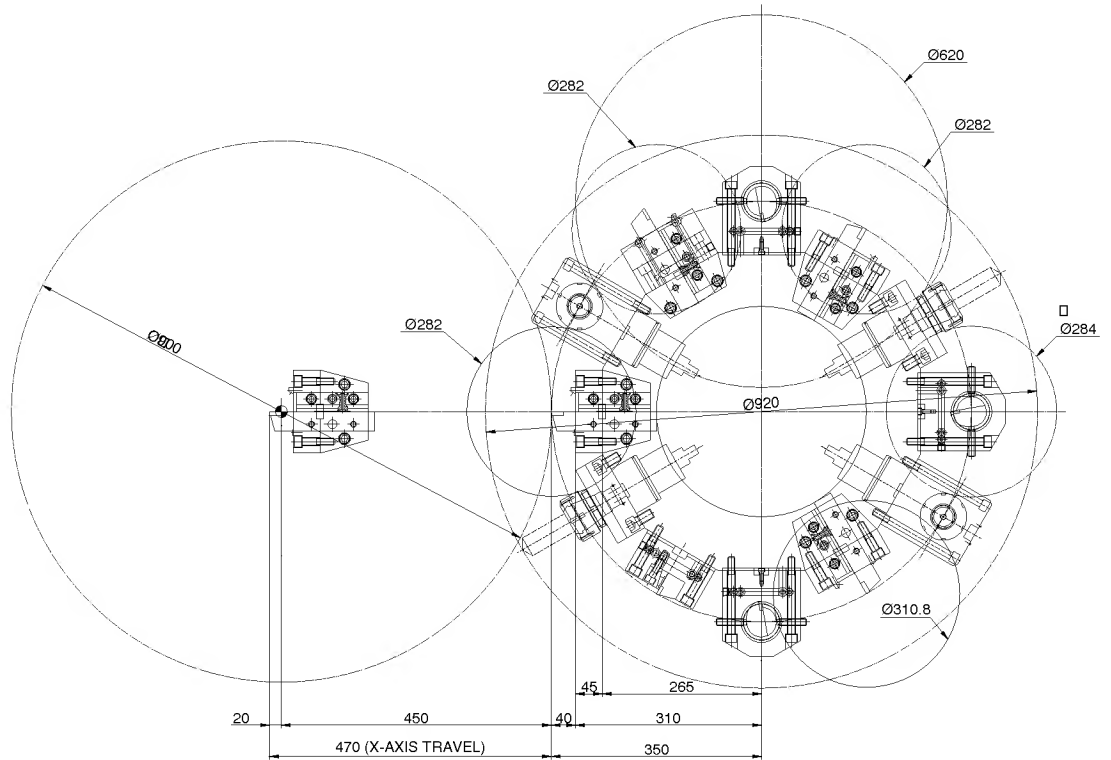


5. Tool interference

5.1 PUMA VT900/VT900-2SP

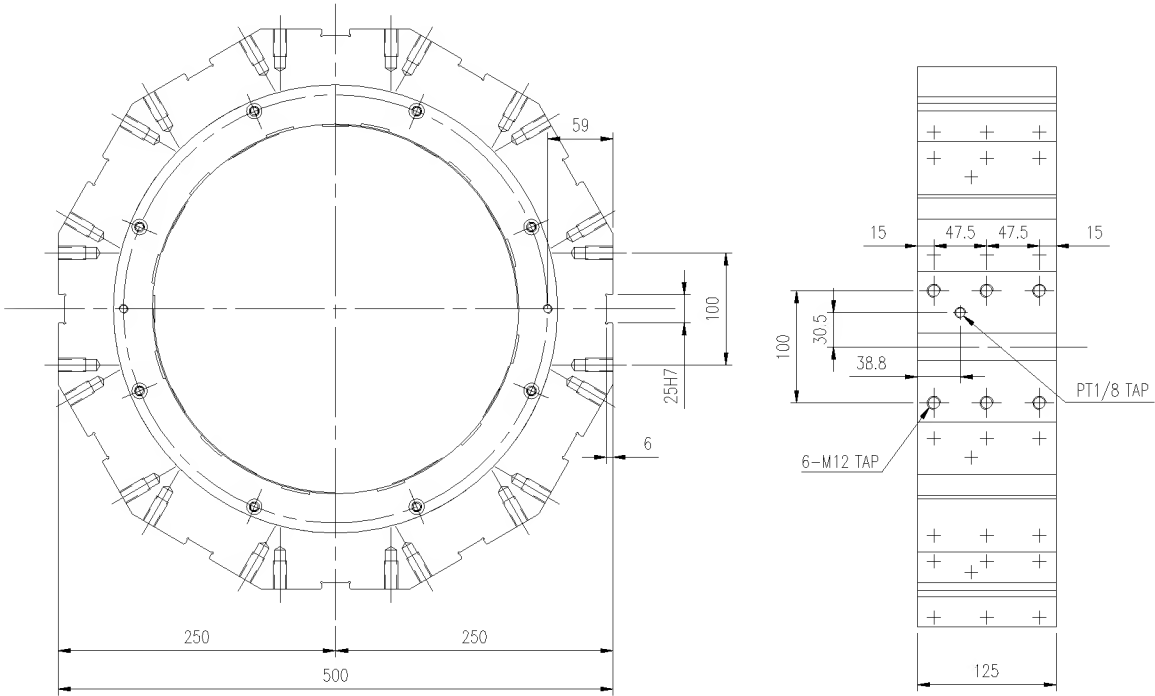


5.2 PUMA VT900M/VT900M-2SP

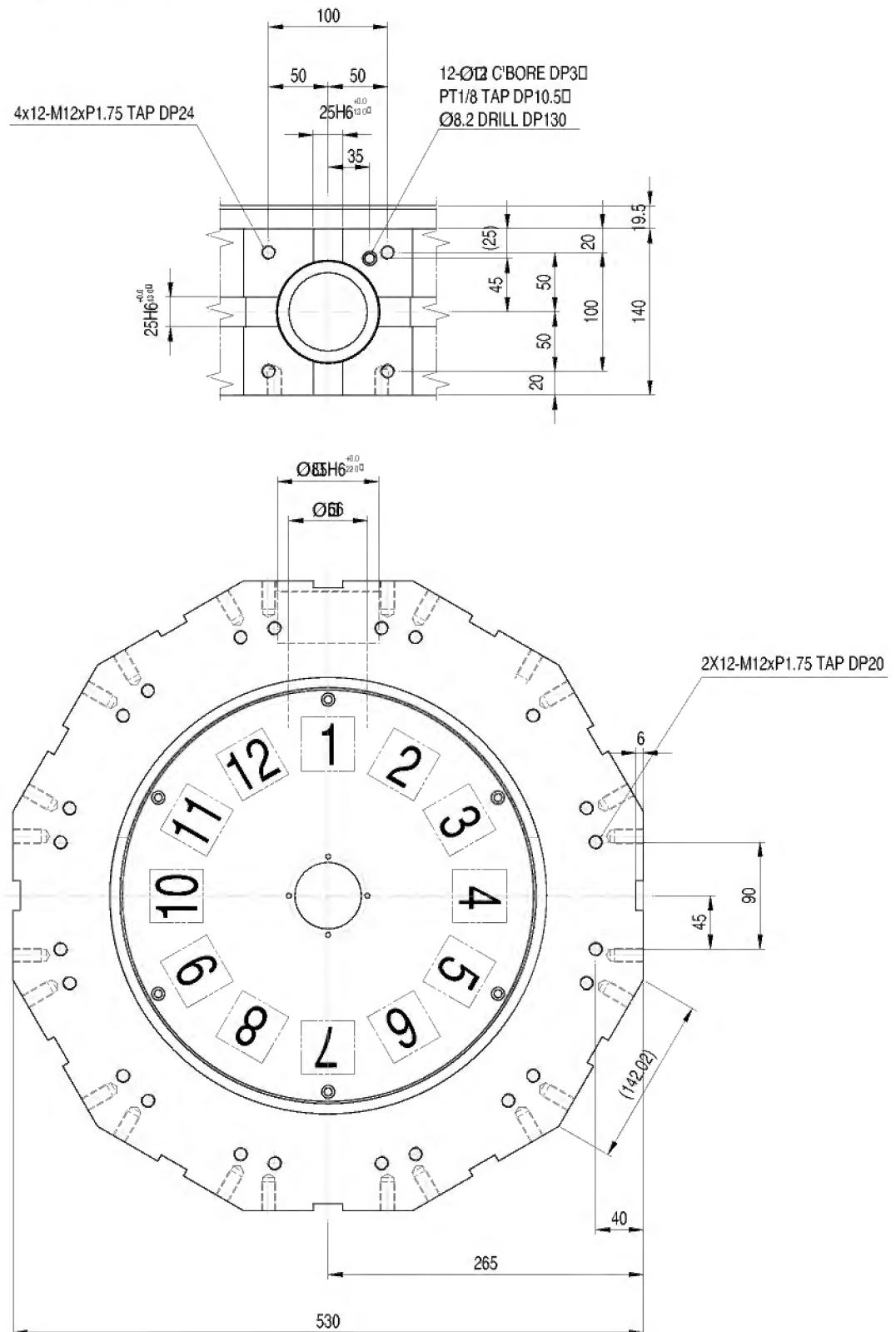


6. Turret dimension

6.1 PUMA VT900



6.2 PUMA VT900M



7. Cautions for attaching tool holder

WARNING

Do the task after disconnect the power supply and reserve the safety when you repair the machines.

CAUTION

- 1) In case of attaching Tool Holder on Turret Head, be careful of balance in Turret Head.
- 2) In case of locking Holder or clamping bolt, use designated tool.
- 3) In case of locking bolt, control the power of yourself, and then lock it slowly and gradually.
- 4) Do not lock Holder or locking bolt more than is necessary.
- 5) In case of attaching Holder or fixed metal, do it without different substance.
- 6) In case of flaw on the surface of Holder or fixed metal intended to attach, smooth the flaw with a grinding stone.
- 7) Be sure to close up the Coolant Hole of Turret Station not to be attached with Holder, using a headless wrench. When using without closing up it with a headless wrench, Coolant doesn't flow from the hole because of different substance in Coolant Pipe.

SECTION C

SAFETY PRECAUTIONS

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1. Instruction

- 1) The purpose of safety precautions is to protect operator injury and machine damage from incidental accidents.
Safety precautions must be understood and observed because they will be applied to the setting and operations of all machine as well as this machine.
- 2) Fully understand the safety guidance and Instruction / Operating manual then operate the machine. DOOSAN Infracore has no responsibility in case that the indicated precautions wouldn't observed and / or accident due to improper use.
- 3) There are 3 kinds of safety regulations such as DANGER, WARNING and CAUTION related to safety in this manual. Their meanings are as follows.

[Symbols]

The following warning indications are used in this manual to draw attention to information of particular importance.

DANGER

: Indicates an imminent hazard which, if not avoided, will result in death or serious injury.

WARNING

: Indicates hazards which, if not avoided, could result in death or serious injury.

CAUTION

: Indicates hazards which, if not avoided, could result in minor injuries or damage to devices or equipment.

2. User Professional Profile



All machine operators must:

- read and understand the machine manual;
- receive the proper formation and training for the specific job;
- receive the proper formation and training for the correct and safe machine use;

2.1 Operator Man/Woman



Machine operator must know at least the following items:

- Materials technology and experience in machine tool operation.
- Basic general culture and technical knowledge of sufficient level for reading and understanding the manual content and technical drawings.
- Operation and programming rule for microprocessor based control system (NC), must know how to verify the correlation between data changed on NC and the effect on machine work production, must know the action to do in consequence of machine alarm messages and call right technical people or authorized assistance company in case of not normal situations.
- Technical knowledge (in electric, mechanic, hydraulic and pneumatic fields) sufficient for safe execution of competence jobs specified in operator manual.
- Safety norms:
 1. General norms for, for example, safety on workplace or accident prevention.
 2. Specific norms depending on, for example, machine kind, or laws in act in the country where the machine is installed and used.
- How to verify the right functionality of every machine safety systems (for example, work area door interlock, main modal key selector, and so on), and in case of trouble, how to call immediately the specific technical people or authorized assistance company.
- Forbid access to machine and working area for people with no training on this kind of work. If the operator finds a malfunction that can compromise machine safety, he/she must isolate the machine.

The operator that works for normal machine production can't execute repair action on electrical, pneumatic or hydraulic machine parts.

2.2 Maintenance Man/Woman

CAUTION

The maintenance man/woman must be chosen considering the same way used for operator, but he/she also must have some more technical preparation about electric, mechanic, hydraulic and pneumatic systems, so he/she can operate in safety for all the maintenance action specified on machine manual.

It is forbidden for maintenance man/woman to work or operate on electrical wire connection, air or hydraulic pipe connection.

These kinds of works together with not ordinary maintenance must be done only by authorized service company.

Machine manufacturer and mandatory is not responsible for the damage of machine or injury of people caused by incorrect use, unpredictable use or unauthorized machine modification.

Any kind of modification that may effect some machine function or production cycle must be done by authorized service company.

3. Clothing and Personal Safety







CAUTION

- 1) Tie back long hair, which could be entangled driving mechanism.
- 2) Wear safety equipment(helmet, goggles, safety shoes, etc.) that can guarantee the safety.
- 3) Always wear a helmet if there are any overhead obstacles in the work area.
- 4) Always wear a protective mask when machining the workpiece such as magnesium alloys or graphite.
- 5) Never wear loose or baggy clothing.
- 6) Always completely fasten buttons and tie up the arms of clothing to avoid entangling with rotating parts.
- 7) Do not operate the machine while under the influence of drugs with powerful effects, unprescribed drugs, or alcohol.
- 8) Do not operate the machine if you feel faint or lose consciousness.
- 9) Always use gloves when loading or unloading workpiece or tools and when removing chips.
- 10) Always use safety shoes with steel toecaps and oil-resistant soles.

Every operation, maintenance, and cleaning must be done in maximum safety condition, by using safety clothing (check the table).


Follow always the personal safety norms and laws in the country where the machine is used.

Safety Clothing

Title	Symbol	Description
Helmet		Helmet must be used in case of machine installation in place with risk of falling object.
Gloves		Gloves must be used in case of work with material with spike or cutting edge, oil, coolant, workpiece with dirt of oil or coolant, chips, and so on. Gloves must not be used in case of work on CNC keyboard or operator panel.
Safety Shoes		Safety shoes must be always used
Working clothe		Working clothe must be always used.
Safety Glasses		Safety glasses must be used when use air or coolant gun.
Ear Protector		Ear protector must be used when work with air gun or when it is requested due to the acoustic condition of work place.

4. General Safety

⚠ DANGER

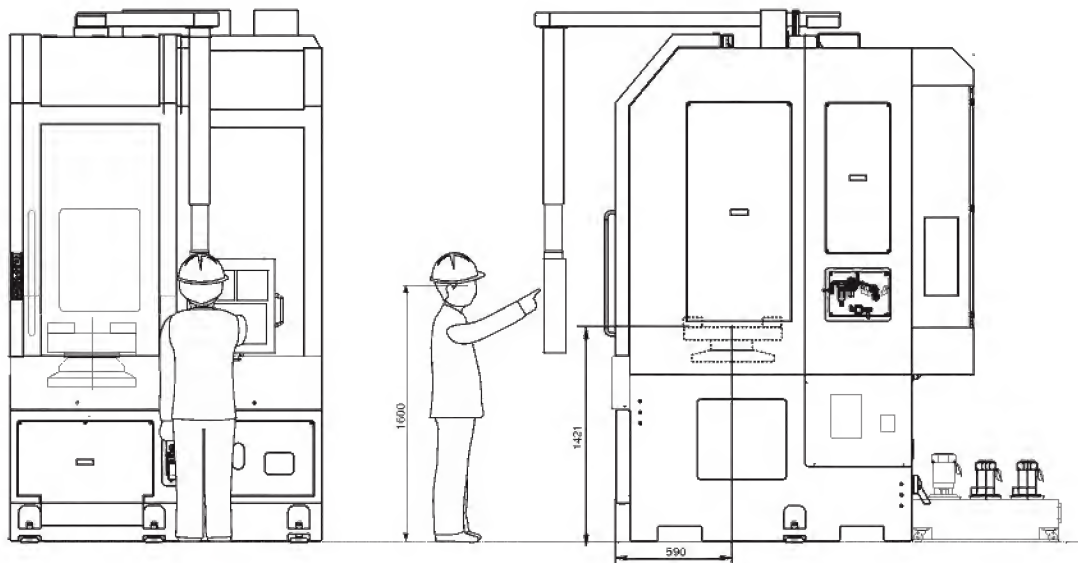
- 1) There are high voltage terminals on the electrical cabinet, transformer, motors, junction boxes, and other equipment (with a battery warning mark  attached).
Never touch any of them.
- 2) Make sure that all doors and covers should be closed before turning on the power. If any door or cover is opened, first stop the work and cut off the main breaker.
- 3) Never modify the machine in any way that will affect its safety.
We take no responsibility for any personal accidents or machine trouble due to improper use.
- 4) Never touch the rotating workpiece or tool with your bare hands or any other objects.
Fail to observe this warning may result in a fatal wound due to contact with the rotating workpiece.

⚠ WARNING

- 1) Make sure to memorize the position of the EMERGENCY STOP button so that you can press it immediately from any position.
- 2) Take care not to touch any of the switches arbitrarily while the machine is in operation.
- 3) Never touch your fingers in chuck or tool.
- 4) To prevent incorrect operation of the machine, carefully check the position of the switches before operation.
- 5) If finding out any doubtful thing from the machine, stop the machine operation immediately and call the responsible person then operate the machine again after solving its trouble.
- 6) Always turn off the power switch on the operation panel and main power breaker before leaving the machine so that someone else can not operate it arbitrarily.
- 7) If two or more operators work together, establish mutual signals so that they can communicate to confirm the safety to each other before proceeding to each new step.
- 8) Do not touch a rotating workpiece or the tool with your bare hands or any other object.
- 9) Do not modify the machine in any way that will affect its safety.
Be sure to use the specified and standard parts as replacement or consumable parts so as to maintain the shipped machine specifications.
We don't take any responsibility for personal accidents or machine trouble due to inobservance of this warning.
- 10) Do not stay in front of the chuck area while a spindle is rotating.
- 11) We don't take any responsibility for personal accidents or machine trouble due to unauthorized attachments, modification, any other abuse or misuse by a customer.

CAUTION

- 1) If there is a power failure, turn off the main power breaker immediately.
- 2) Take care not to impact the CNC unit, the operation panel, or the electrical cabinet.
- 3) Do not change the parameter or other electrical setting values without valid reason. If it is necessary to change a setting value, first check that it is safe after confirming its work from the responsible person and then make a note of the original value so that it can be reset.
- 4) Never remove and/or damage any of the safety nameplates. If the nameplates become illegible or damaged, purchase it from Doosan Infracore and attach the replacement its original position so that everybody can see it.
- 5) Do not open any doors or safety covers while the machine is in automatic operation.
- 6) Stop all machine operations and turn off the power before cleaning the machine or any of the peripheral equipment.
- 7) After a job has been completed, set up each part of the machine so that it is ready to be for the next series of operations.
- 8) Do not eject the compressed air of the air gun to the human body.



5. Safety Related to Operation

▲ DANGER

- 1) Do not adjust the coolant nozzles while the machine is in operation.
- 2) Do not remove or move the safety devices such as dogs, limit switches in order to increase axis travel.
- 3) Do not wipe the workpiece or remove chips with your hand or with a rag while the tool is rotating; always stop the machine and remove chips using the brush.
- 4) Do not operate the machine with any of the safety covers removed.

▲ WARNING

- 1) Close all doors and covers of the CNC unit, operation panel, electrical cabinet, and junction boxes to protect the damage from coolant, chips and oil.
- 2) Check all electrical cables for damage to prevent accidents due to current leakage or electric shock.
- 3) Do not handle coolant with bare hands since it may cause irritation. Operators with allergies should take special precautions.
- 4) Do not operate the machine during violent thunderstorm like thunder or lightning.
- 5) Check the safety covers regularly to make sure that they are properly closed and that they are not damaged. Repair or replace any damaged covers immediately.
- 6) Always obtain assistance in handling loads beyond your capacity.
- 7) The work for fork lift, crane or hoist must be carried out by the authorized person.
- 8) When using fork lift, crane or hoist, make sure that there are no obstruction in the vicinity of machine working range.
- 9) When lifting the machine, workpiece or other parts, always use suitable wire rope or slings so as to secure from load. Refer to the instruction manual as regards to the machine's weight or installation.
- 10) Be sure to check the sling, wire rope, crane, hoist or forklift before using it. If finding out the defectiveness, repair or replace it immediately.
- 11) Always wear gloves and use a brush to remove chips from tool tips; never use bare hands. Fail to observe this warning may result in serious injury.
- 12) Stop all machine operations before mounting or removing a tool.
- 13) Switch key related to the safety must be managed by the responsible person: locking-release key of safety door, electrical cabinet key.
- 14) Do not stay in front of the chuck area while a spindle is rotating.
- 15) We don't take any responsibility for any personal accidents or machine trouble due to unauthorized attachments, modification, any other abuse or misuse by a customer.

⚠ CAUTION

- 1) Do not allow chips to accumulate during machining the heavy-duty workpiece since they become hot and may take fire.
- 2) Check that the belts such as spindle, feed axis and tool post have the correct tension before operating the machine.
- 3) Warm up the spindle and all of the axis feed mechanisms before operation. (Operate the machine in the automatic mode for 10 to 20 minutes at 1/3 to 1/2 maximum spindle speed or maximum axis feed rate.)
- 4) Make the program for the warming-up operation so as to execute the function of the full range of machine components, If operation is to be performed at maximum spindle speed, pay special attention to the warming-up operation.
- 5) Do not operate the switches on the operation panel with wearing gloves, which could lead to incorrect operation or other mistake.
- 6) When finishing the work, turn off the switch as following order; power switch on the CNC operation panel, main power breaker and factory power supply.

6. Safety Related to Gripping Workpiece and Tooling

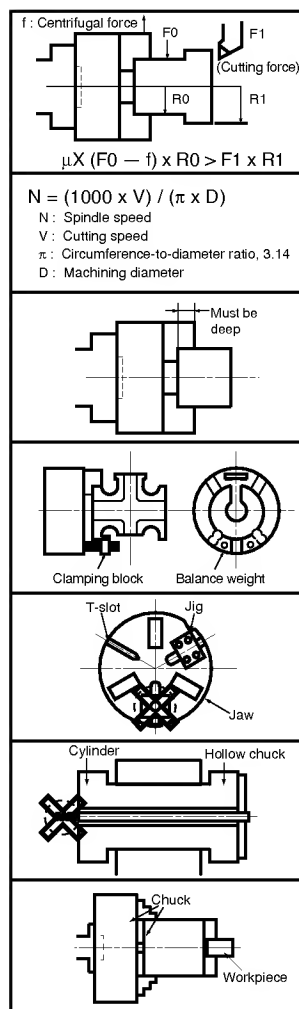
⚠ DANGER

- 1) Do not rotate the spindle more than maximum allowable speed. This may result in fatal injury that spring out the workpiece.
- 2) If the chuck or the jig being used is not Doosan Infracore products, check the maximum safe operating speed and maximum allowable pressure of the manufacturer, then operate them within maximum conditions.
- 3) Make sure to set the machining condition securely when cutting the heavy or big diameter workpiece. Set the machining condition according to the instruction manual of chuck maker.

⚠ WARNING

- 1) Always use tools suitable for the work and which conform to the machine specifications.
- 2) Replace tools quickly since badly worn tools may result in a sudden accident or machine damage.
- 3) Before starting to rotate the spindle, check that any part which are bolted or clamped to the chuck or the steady rest are properly secured.
- 4) If the center hole on large bar workpiece is too small, the workpiece could come off when a load is applied. Make sure that the hole is big enough and that it has the correct angle.
- 5) Take care not to be caught your fingers in the chuck.

- 6) Always use the crane or lifting gear for heavy chucks, steady rests, and workpieces.
- 7) Be sure not to turn off the power under the condition of clamping the workpiece.
- 8) Always close the front shield before starting to rotate the spindle.
- 9) Specially pay attention to the machining condition and the workpiece balancing when the spindle is rotating at maximum allowable speed.
- 10) If special jaws(larger than standard soft-top jaws) are used, observe the following points:
 - Lower the spindle speed because centrifugal force reduce the gripping force of chuck.
 - Jaw nuts must be positioned within outer diameter of the chuck.
 - Machine the jaws with the workpiece shape.
- 11) Securely tighten the bolts on the chuck body and the jaws to the specified torque according to the instruction manual of chuck maker.
- 12) For safe chucking



1. The gripping force of chuck must be set to enough the safety factor(2~3 or more). Run the spindle within the allowable speed range.
2. In constant peripheral speed cutting, calculate the actual machining speed before designating G50 (maximum speed limit function).
3. Secure the jaw gripping depth as much as possible.
4. Before machining an unbalanced workpiece, carry out balancing of the workpiece weight by gradual changing the spindle speed.
5. Never attempt to install jigs using T-nut.
Be sure to fix the jigs with bolts.
No chucks prepared by DOOSAN Infracore have T-groove.
6. When inserting a bar material into the hollow chuck, ensure that the bar does not protrude from the rear end of the cylinder.
7. Never use double chucking method.

13) If the spindle must be rotated close to the maximum allowable spindle speed, observe the following points:

- Make sure that the workpiece clamped in the chuck is balanced.
- Apply the allowable maximum amount of pressure to grip the workpiece because centrifugal force reduces the chuck gripping force.

The maximum allowable spindle speed and application pressure are indicated on the name plate on the front shield and on the chuck body. The allowable maximum speed and the applicable pressure ensure a chucking force that is more than one-third over the original chuck gripping force with the standard soft-top jaw set in line with the periphery of the chuck body.

14) Since the tool holders can be mounted from the left or the right, check that the tool holder is mounted facing the correct direction.

15) Spindle chuck must be adjusted so the radial stroke is no more than 4 mm over workpiece dimension, and it is very important to clean and grease at least every week at the chuck guide for keeping clamping force.

16) Tools setting must be done in axes and spindle stopped condition. In the tool setting and maintenance phase, it is necessary to pay attention to tool spike and turret position to avoid interference with machine parts or body parts. Tool and tool holder screw tightening torque must be as specified in normalized ISO table.

CAUTION

- 1) Make sure that the tool length is not to interfered with fixtures or other objects.
- 2) Perform a test operation after mounting a tool.
- 3) After machining soft jaws, check that the workpiece is correctly clamped and the chuck pressure is correct.

7. Safety Related to Maintenance

DANGER

- 1) Always Turn off the main power breaker and lock it before carrying out any maintenance work so that someone else can not operate the machine inadvertently during maintenance work.
- 2) After the power has been turned off for a short while, check the voltage with a multimeter or similar instrument to make sure that there is no residual voltage. Also discharge the capacitors.
- 3) The inclined or vertical feed axes are installed with servo motor or electromagnetic brake device so that their feed axes can not slip down automatically by brake mechanism even being turned off the power.
- 4) Do not remove or modify overtravel limit switches, interlock limit switches, proximity switches, or other safety devices.

 WARNING

- 1) Maintenance work for electrical parts must be carried out by qualified personnel.
- 2) Even if the door of the electrical cabinet is open, the power can not be cut off. When working inside the electrical cabinet or repairing the machine, always turn off the main breaker and lock it with key.
- 3) When carrying out maintenance in high places, always use a suitable ladder or a service platform and always wear a helmet.
- 4) Always turn off the main power breaker and lock it before electrical work is carried out.
- 5) Never approach your hands such as belts or pulleys.
- 6) Do not start the machine until all of the removed covers for maintenance have been refitted.
- 7) Wipe up any water or oil immediately so as not to slip and keep the maintenance area and the workplace clean and tidy at all times.
- 8) Check that working tool is still remained around machine inside or vicinity after maintenance work: this is extremely dangerous.

 CAUTION

- 1) Maintenance work should be carried out by qualified personnel in accordance with the instructions of the person in charge.
- 2) Always use the Doosan Infracore replacement parts or approval parts.
- 3) Read the manuals thoroughly first then perform the machine operation and the maintenance work.
- 4) Do not use compressed air to clean the machine or to remove chips.
- 5) Always use gloves when removing chips: never touch chips with bare hands.
- 6) When changing a fuse, check that the new fuse has the correct rating. (Using a fuse with too high a rating could result in damage to the equipment.)
- 7) Use only the specified grades of hydraulic oil, lubricating oil, and grease or their equivalents.
Follow the instructions indicated on the instruction plate concerning the brands of oil to be used, lubrication points, amount to be used, and oil change intervals.
- 8) If one of the belts in a set has stretched beyond the prescribed limit, change the entire set.
- 9) Stop all machine operation before cleaning the machine or the surrounding area.
- 10) Disposal of industrial waste such as oil, coolant, chips and refrigerants is to be performed in strict compliance with environmental protection laws as stipulated by the proper national and local authorities.

8. Safety Related to the Workplace

WARNING

- 1) Immediately remove all water and oil spills from the floor of machine vicinity and keep the floor dry to prevent accidents.
- 2) Keep combustible materials away from the work area and any other place where there are hot chips.
- 3) Always provide sufficient lighting in the work area.
- 4) Always provide sufficient working space for maintenance work when installing the machine.
- 5) Never place tools or other potentially dangerous object on top of the headstock, turret and covers.
- 6) Protect all cables which are along the floor from being damaged by chips: damaged cables and wires will cause current leakage and short-circuit.
- 7) Use strong service platforms only and make sure that nothing can slip off them.
- 8) Make sure that the nominal cross-sectional area of the power supply cable between the factory power supply switch and the machine main power breaker is such as to enable a stable supply for operation at the maximum output.

9. Safety Related to the Chip Conveyor

CAUTION

- 1) Before carrying out maintenance work or other jobs on the chip conveyor, make sure that the power supply is turned off and that the conveyor itself is placed in the completely stopped status. Failure to observe this precaution causes serious personal injury.
- 2) During the operation of the chip conveyor, keep hands away from and do not insert any region of your body into any sections of the conveyor. Chip conveyor can be operated at any time under condition that the power is turned on, therefore never touch it.

10. Other Precautions

10.1 End of Work



At the end of daily working cycle, switch off the main power and start a manual machine cleaning phase and after apply a thin layer of protective oil to axes guideways and chuck.

10.2 Electric Cabinet and Numerical Control(NC)



At the end of machine installation done by technicians of authorized service company, NC parameters must not be changed, and removal or modifications of safety device or part of electric cabinet are not allowed because all these things can generate dangerous machine malfunctions; machine manufacturer and mandatory will be not responsible for this.

If some parameter needs to be changed, please contact the authorized service company.

Switch off the main machine power, and disconnect the power cable where possible. And perform test by using some instrument if effectively the power is off before doing checking or maintenance of the electric cabinet or of electric parts.

Whatever maintenance action, if not belong to those specified in the present manual, must be done by technicians of authorized service company.

11. Machine Insulation



Machine insulation means that the machine will be separated from all it's energy source.

Typically machine tool have electric and pneumatic energy, so :

switch off the main breaker and key-lock it in that condition and close the air valve and lock it in that condition.

When the machine is in insulation condition it is possible to do fix operation, maintenance operation and so on.

12. Residual Risks

WARNING

In normal production cycle and maintenance time the operators are exposed to some residual risks that cannot be avoided:

- Cutting risk caused by steady tools and chips.
- Entrapping risk caused by inadequate clothing, typically too large.
- Electric energy shock risk in electric cabinet even if the main power switch is open.
- Coolant and oil contact risk during normal production cycle and specially during maintenance time.
- Crushing risk caused by axis/spindle movements when main modal key selector in "manual/maintenance".
- Chuck, tailstock, steady rest contact risk during normal production cycle.
- Coolant smoke and dust inhalation risk caused by special work execution or materials.
- The machine is equipped with the predisposition for external vacuum cleaner pipe connection.

All machine covers and protection systems are designed to resist to the risk of normal machine working limits.

13. Fire Preventions

DANGER

Non water soluble coolant has the potential to catch fire if it vaporizes or forms a mist inside the machine. Pay close attention to the following points to prevent the occurrence of a fire.

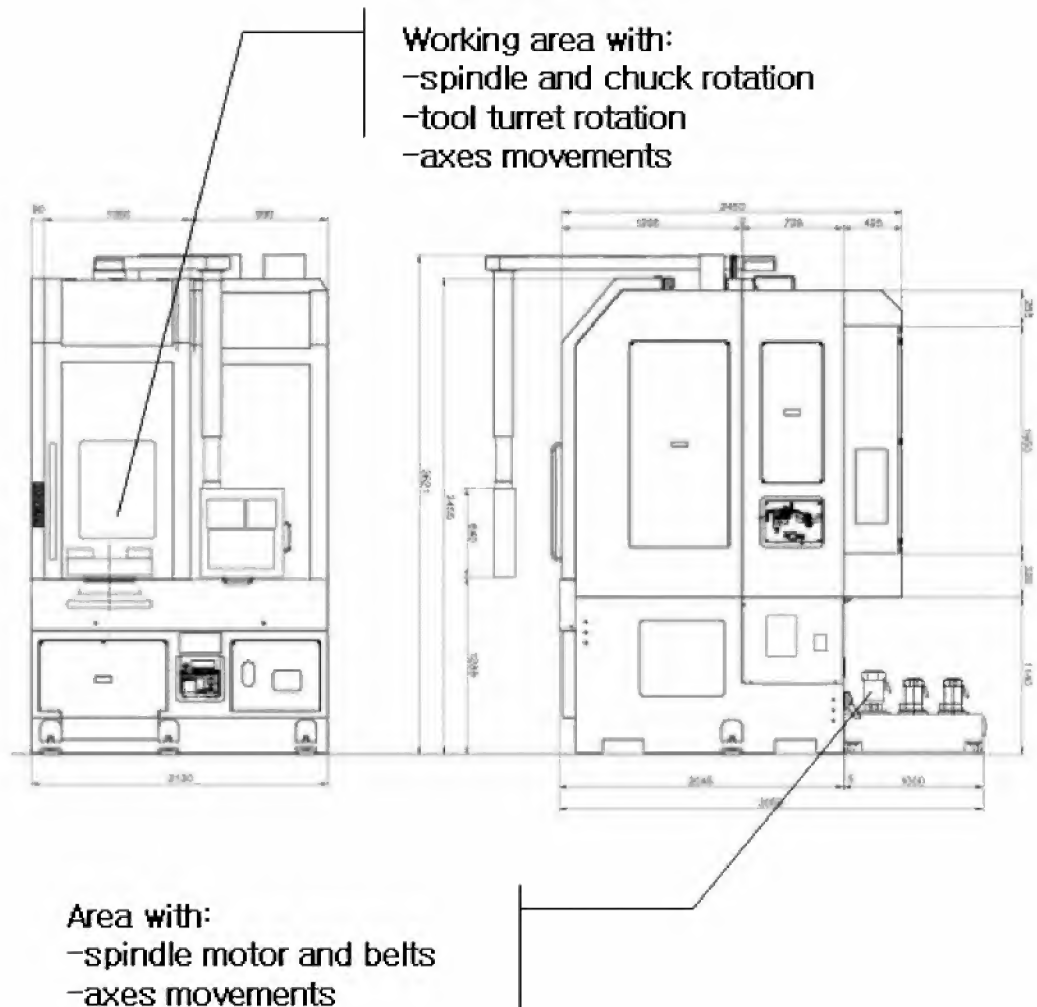
- Never use anything flammable near the machine.
- If an automatic fire extinguisher is not installed, place a fire extinguisher near the machine.
- When the automatic fire extinguisher and mist collector are used together, attach a shutter so that mist can be stopped for safety. Attach the shutter between the machine and the mist collector.
- Never carry out machining that exceeds the machine specifications.
- Check that the discharge amount and direction of coolant are correct.
- Check whether or not the moving parts or cutting chips alter the direction of the coolant nozzle.
- Check that the safety devices (coolant level detector, broken cut-off tool detector, etc.) function normally.
- Ensure that all the doors are closed during operation.

14. Dangerous Area

The dangerous area on machine are:

- A. Working area, where there is risk coming from spindle rotation, tool turret rotation, axes movements.
- B. Machine internal area, where there is motor, actuator and transmission device like gears and/or belt, this area is protected by fixed covers.

Dangerous Area



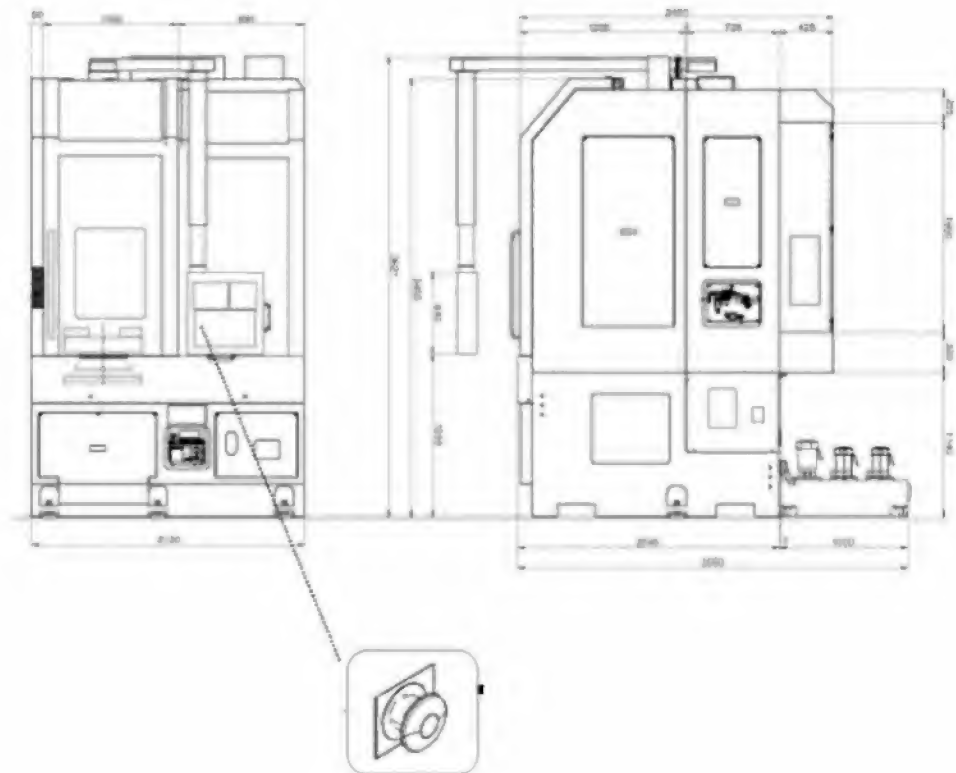


15.2 Emergency stop switch

⚠ WARNING

- 1) Be ready to press the "Emergency stop switch" button during machine operation.
- 2) Do not place any obstacle in front of an "Emergency stop switch" button.
- 3) Even when the "Emergency stop switch" button is pressed, confirm all operations have come to a complete stop before approaching moving parts.

Emergency stop switch

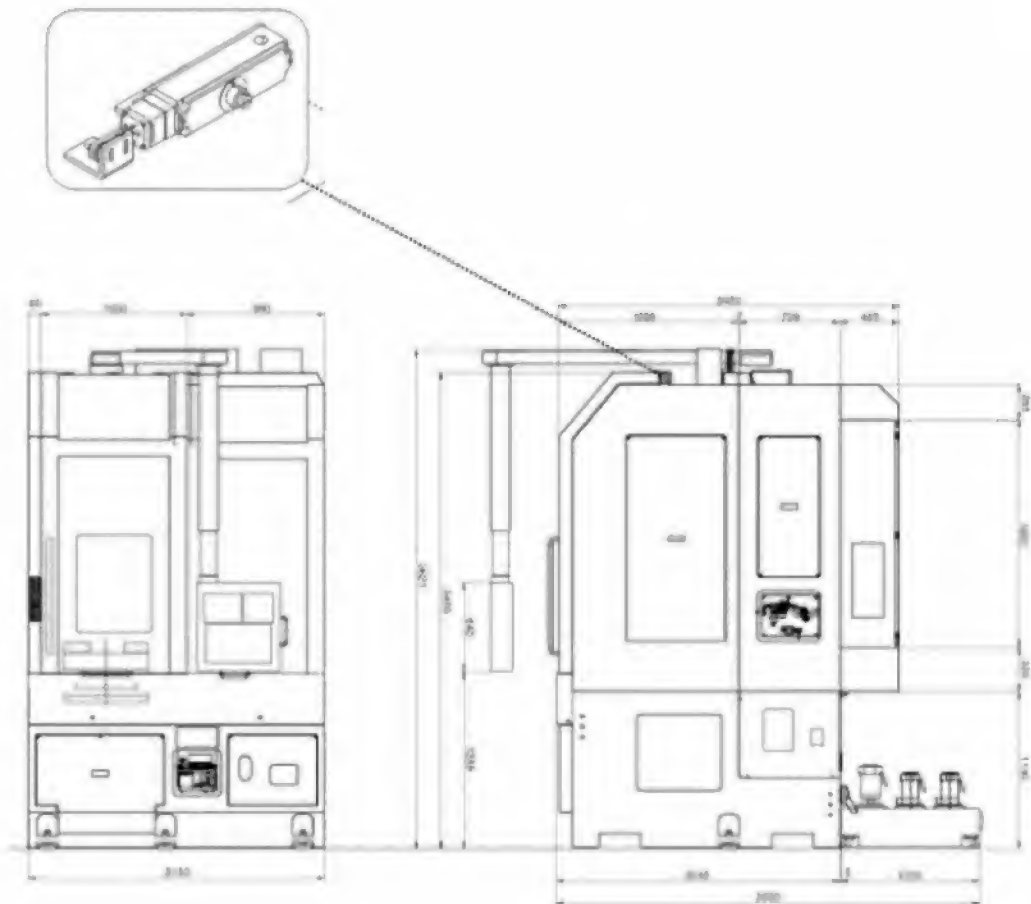


15.3 Interlocking device



Note that releasing the door interlock function to enable limited machine operations with the door open is extremely dangerous.

Interlocking device



16. Release of Operators Trapped in Machine

Doosan PUMA Turning center series

In this paragraph, the procedure is described to follow how to free operators got trapped among the moving parts of machine by accident.

In the next pages it is reported the most probable trapping situation that can happen during the normal use of machine, and the procedure and operation sequence how to free operators in case of energy presence and energy absence.

NOTE




The sentence “energy presence” means that all the energy types used by the machine are available (ex: electric, hydraulic, pneumatic, etc.) and the machine command circuit is active. All the operators that can execute this procedure must be technically prepared on using and working of machine tools.

DANGER


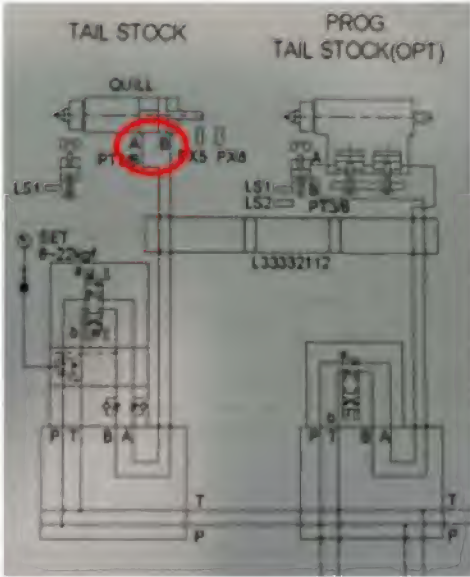
The first thing to do is to evaluate with attention the machine conditions and the conditions of the operator trapped between machine moving parts.

Push immediately Emergency Stop Button for stop every machine movement and command.




16.1 Trap between Workpiece and Tail stock (Energy presence)

Energy presence	
1. Unlock/Release emergency button head	
2. Turn ON machine by pressing machine ready green button (button A), after that reset alarms, if present, by pressing alarm reset blue button (button B).	
3. Select manual mode by rotary modal selector as indicated in the picture.	
4. Command tail stock backwards by foot switch (foot switch B)	

16.2 Trap between Workpiece and Tail stock (Energy absence)

Energy absence	
<p>1. Disconnect the two hydraulic pipes marked by the circle in the picture.</p>	
	
	<p>2. Push backwards the tailstock cylinder, if it is too hard to push it, a lever can be used.</p>
<p>3. When the operator is free and out of machine, reconnect the hydraulic pipe immediately.</p>	

16.3 Trap between Turret and Workpiece or Spindle (Energy presence)

Energy presence	
1. Unlock/Release emergency button head	
2. Turn ON machine by pressing machine ready green button (button A), after that reset alarms, if present, by pressing alarm reset blue button (button B).	
3. Select maintenance mode (position I) by rotary modal selector as indicated in the picture.	
4. Select Handle or Jog mode for X or Z axes by rotary selector and move the carriage in the right way to free the operator.	

16.4 Trap between Turret and Workpiece or Spindle (Energy absence)

Energy absence

Horizontal axis (X)

This is the case of turret movement along the axis parallel to floor (horizontal), this movement can't be caused only by gravity force.

- a) - First of all, consider to get off some tool holder and/or:
- b) - Open and /or get off the mobile and/or fix cover for free access to X axe motor and brake.
 - Get off the motor and exclude the brake system so X axis movement is free.
 - By hand or by using a tool, try to rotate the axis screw in the right direction for free the operator (turret go away from spindle).

Vertical axis (Z)




This is the case of turret movement along the axis inclined or vertical to floor, this movement can be caused only by gravity force.

- a) - First of all, consider to get off some tool holder and/or:
- b) - Insert an axis locking element (iron bar or wood bar of right dimensions) to avoid axis fall down due to gravity force when brake will be removed.
 - Open and/or get off the movable and/or fix cover for free access to Z axis motor and brake
 - Get off the motor and exclude the brake system so Z axis movement is free.
 - By using a tool try to rotate the axis screw in the right direction for free the operator (turret go away from spindle).

WARNING

In the first stage of removing the axis locking element, the brake systems must be restored, if this operation is not done, the axis can fall down by gravity force.

16.5 Trap in Spindle Chuck System (Energy presence)

Energy presence	
1. Unlock/Release emergency button head	
2. Turn ON machine by pressing machine ready green button (button A), after that reset alarms, if present, by pressing alarm reset blue button (button B).	
3. Select manual mode by rotary modal selector as indicated in the picture.	
4. Command chuck open/close by foot switch (foot switch A).	

16.6 Trap in Spindle Chuck System (Energy absence)

Energy absence
Get off the three chuck grips and pay attention to avoid the workpiece falling down situation by using a support system.

17. Emission

17.1 Ionizing Radiations

This machine's radiation emissions are only electromagnetic low frequency type.

Test measure was done to demonstrate that radiation levels are within the allowed range specified in directive 2006/42/EC, please check the table below.

Measured Magnetic Field

Maximum Measured value [nT]	Measure Point	Frequency	Max Limit (2006/42/EC)[nT]
1139,1	Electric cabinet	< 400 Hz	5000

Measured Electric Field

Maximum Measured value[V/m]	Measure Point	Frequency	Max Limit (2006/42/EC)[V/m]
5,42	Electric cabinet	2 ~ 400 kHz	10

Ionizing radiation level in other place of machine are less than these reported in table so finally the machine isn't a source of danger in this field.

17.2 Not Ionizing Radiations

The emission level for not ionizing radiations are negligible so it does not represent a risk for machine users.

17.3 Vibrations

If the machine is used in the right conditions and the maximum rating is respected, the vibrations level is low and not represent a danger.

17.4 Noise Emission

- 1) The machine was checked for noise level based on actual norms.
- 2) Noise level during normal work condition is not over 80dB.
- 3) Particular care must be taken when air gun is used, the air gun can generate high noise level peak so ear protectors and safety glasses must be used.
- 4) In case of not normal machine noise, it is highly recommended to call immediately the authorized technical service company.
- 5) Values of areal noise produced by the machine, according to section 1.7 4.2 (u) ANNEX 1 of 2006/42/EC DIRECTIVE.

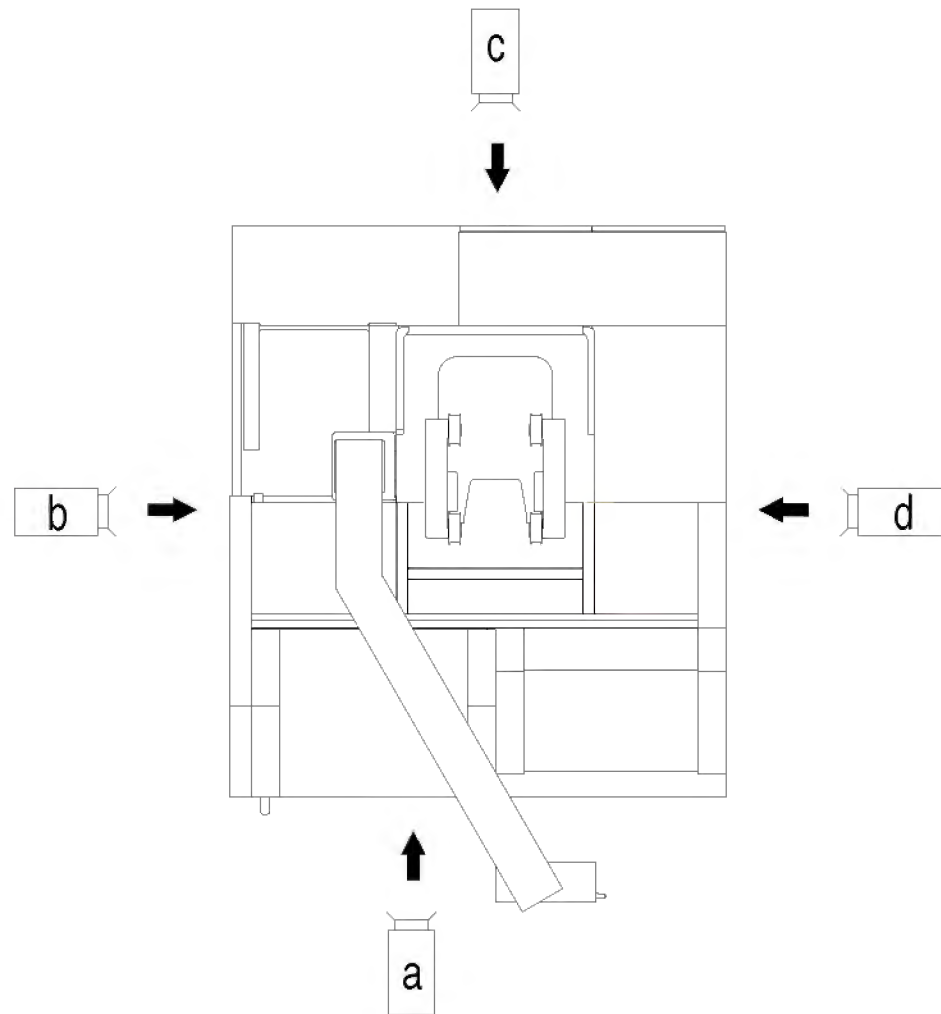
Measuring method : ISO 11202:1997

- The measuring position is four, as shown on drawing and is taken at 1600mm from the floor and at 1000mm from the machine.
- The machine is completely closed with covers.
- Spindle rotation at maximum speed. (not cutting)

Machine Noise Data

Model Name : PUMA VT900

Measuring position		a	b	c	d
Value of the continuous acoustic pressure level if its over 70 dBA (It should be mentioned if it is under 70 dBA.)	dB(A)	85	83	82	83
Maximum value of instantaneous acoustic pressure dBC	dB(C)	< 130	< 130	< 130	< 130
Value of level of emitted acoustic power, if the continuous acoustic pressure level is over 80 dBA	dB(A)				

**NOTE**

- 1) The noise values indicated are emission levels and they don't represent absolute safe level.
- 2) The relation that exists between exposition and emission level can't be reliably used to prove that a specific protection must be used.
- 3) The operator exposition level must consider the time of exposition, the acoustic behavior of the room and finally the presence of other noise source (ex. other machines near the operator).
- 4) The exposition level can be different for different country.
- 5) This information is useful primary for a proper evaluation of risk and danger to which the operator is exposed.

17.5 Electromagnetic Emission

The machine was built for working in electromagnetic environment of industrial type (environment type A as defined in EN 60439-1, net and not public place or low voltage industrial environment).

WARNING

- 1) This machine is for environment of type A. In domestic environment this product can generate interference in radio frequency range, the final user must take care of this fact and find the right solution or require for a special execution to the machine's manufacturer.
- 2) The conformity to maximum level of immunity and emission in case of industrial environment is obtained by the application of product harmonized technical norm.

18. Waste Disposal and Machine Dismantling

CAUTION

This machine is composed mainly with iron, steel, cast iron and other materials like rubber and plastic, all materials that isn't dangerous.

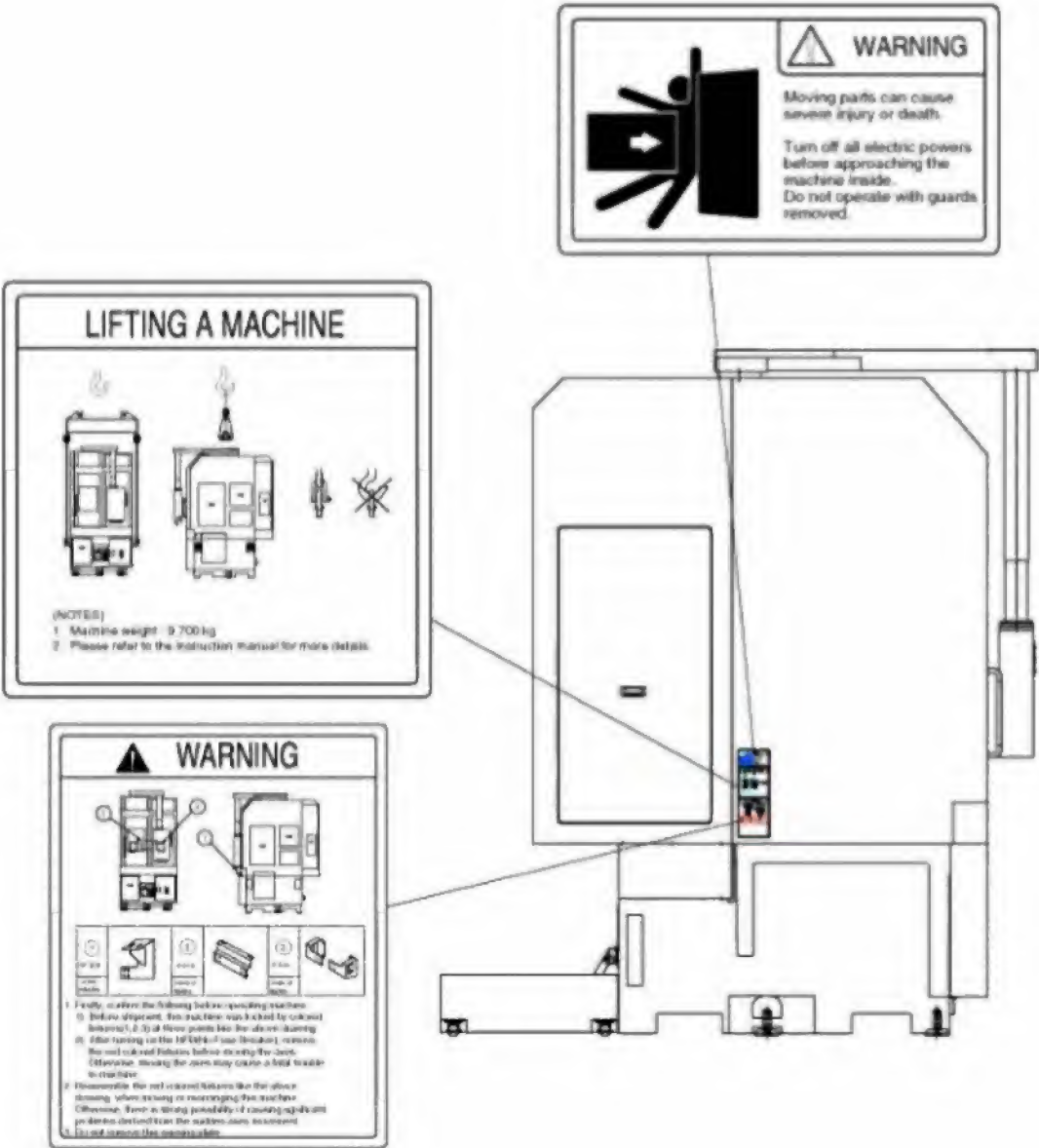
The disposal action of these components doesn't require particular procedure.

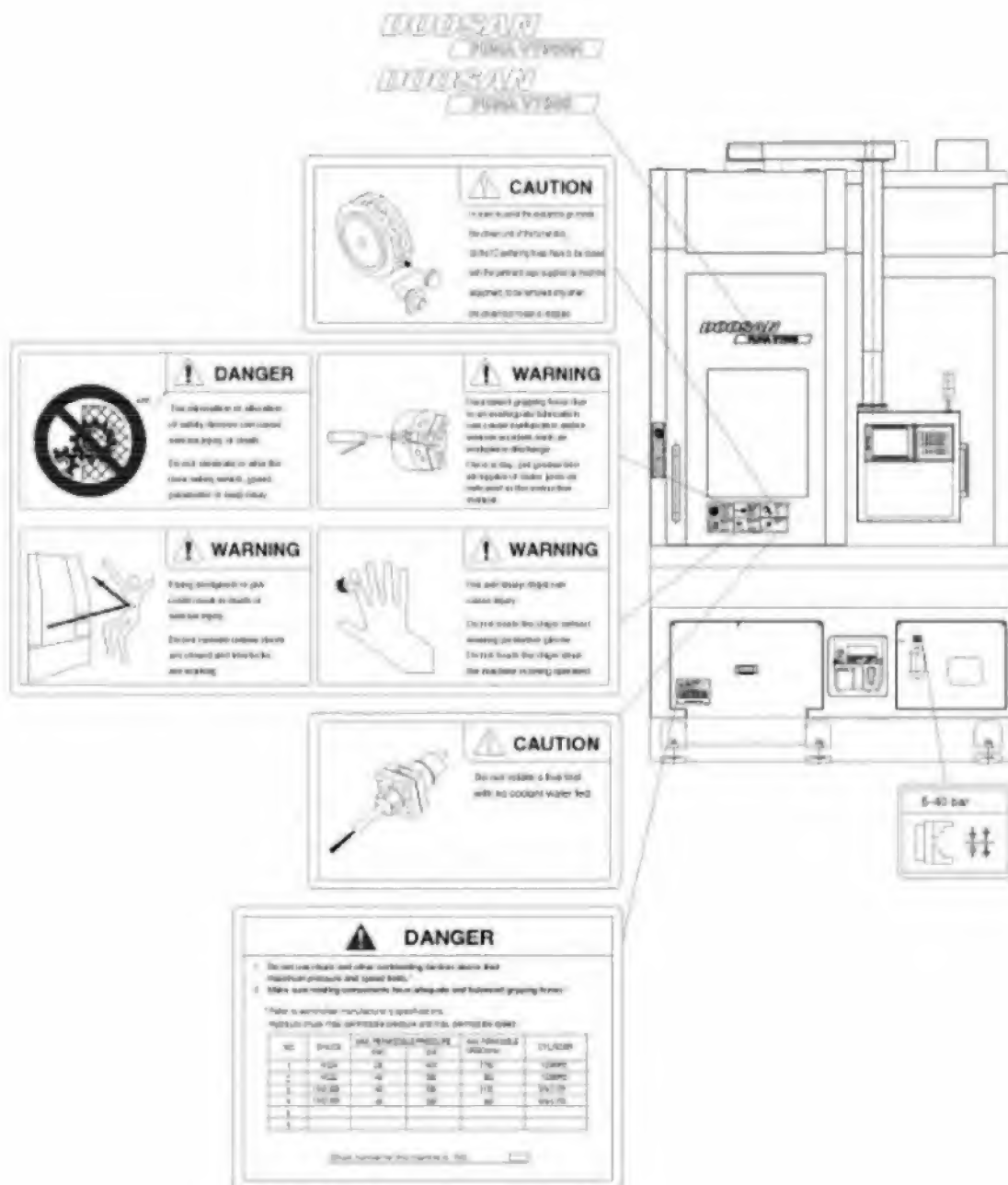
Disposal of oil and other reject materials will be done in observance of environment norms and laws in force for the country of machine installation and use.

19. Safety Precautions Nameplates

CAUTION

Safety nameplates are attached on the machine to secure the operators and the machine from danger. Do not remove these nameplates. If nameplates are damaged or become illegible, please purchase them from Doosan Infracore and make sure that they are attached on their proper position.






WARNING

1. Only qualified personnel should be working on this machine.
2. Do not service the machine while it is running. Do not touch, adjust or tamper with any of the machine's components.
3. Do not remove or tamper with any of the machine's components while it is running.
4. Do not touch the machine's components while it is running.
5. Do not touch the machine's components while it is running.
6. Do not touch the machine's components while it is running.
7. Do not touch the machine's components while it is running.
8. Do not touch the machine's components while it is running.
9. Do not touch the machine's components while it is running.
10. Do not touch the machine's components while it is running.


CAUTION

1. Do not touch the machine's components while it is running.
2. Do not touch the machine's components while it is running.
3. Do not touch the machine's components while it is running.
4. Do not touch the machine's components while it is running.
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6. Do not touch the machine's components while it is running.
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8. Do not touch the machine's components while it is running.
9. Do not touch the machine's components while it is running.
10. Do not touch the machine's components while it is running.

LUBRICATION CHART



No.	Location	Volume	Frequency	Notes
1	Engine oil	4.5 gal	Every 100 hrs	Check oil level before starting
2	Hydraulic oil	4.5 gal	Every 100 hrs	Check oil level before starting
3	Transmission oil	4.5 gal	Every 100 hrs	Check oil level before starting
4	Grease points	1/2 lb	Every 100 hrs	Check oil level before starting
5	Grease points	1/2 lb	Every 100 hrs	Check oil level before starting
6	Grease points	1/2 lb	Every 100 hrs	Check oil level before starting



DANGER

1. Do not touch the machine's components while it is running.
2. Do not touch the machine's components while it is running.
3. Do not touch the machine's components while it is running.
4. Do not touch the machine's components while it is running.
5. Do not touch the machine's components while it is running.
6. Do not touch the machine's components while it is running.
7. Do not touch the machine's components while it is running.
8. Do not touch the machine's components while it is running.
9. Do not touch the machine's components while it is running.
10. Do not touch the machine's components while it is running.

CAUTION

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2. Do not touch the machine's components while it is running.
3. Do not touch the machine's components while it is running.
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5. Do not touch the machine's components while it is running.
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8. Do not touch the machine's components while it is running.
9. Do not touch the machine's components while it is running.
10. Do not touch the machine's components while it is running.



APPENDIX

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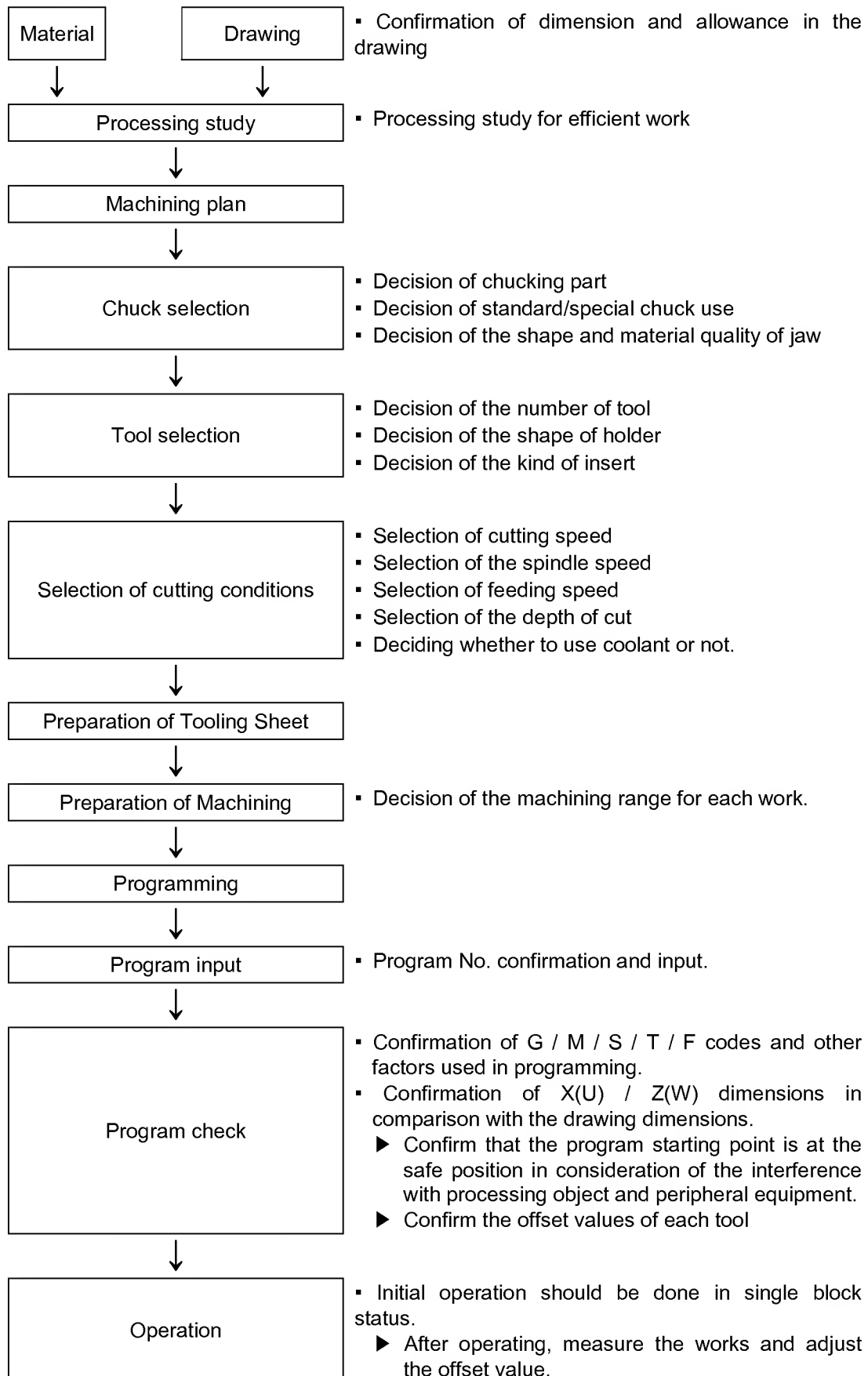
1.	General	1
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1. General

| | |------------| | OBSERVANCE | |------------|

This manual describes fundamental matters to be of help to more effective use of CNC Lathe. See the operator's manual of FANUC for more detailed programs.

2. Programming



3. Key functions and the code

3.1 Dimension Command

1. Absolute value command

Use X/Z, and calculate each dimension on the basis of (X0, Z0), the program zero point.

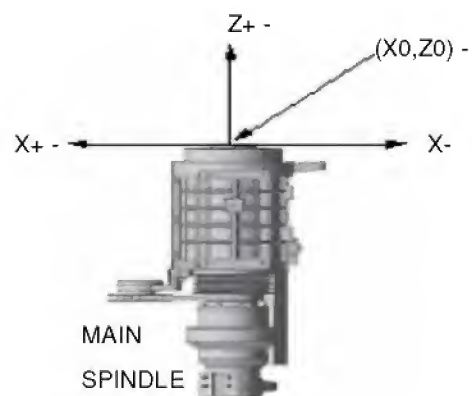
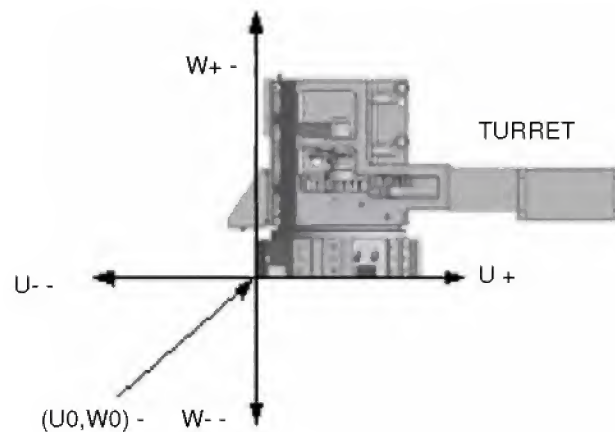
The codes of X/Z are as the following.

2. Incremental value command

Use U/W, and U means X direction, W means Z direction.

Calculate the moving dimension from the present position to (U0, W0).

Use the diameter value for X / U command.



3.2 G Code

This indicates the control function among NC command codes. Command is directed by the next 2 digits after G, which includes 2kinds as the following.

1. One shot code

00 groups are called ONE SHOT code on the list of G code, and the command is valid for the directed block only.

2. Modal code

1) This is G code(01, 02, 05, 06, 07) group except 00 group on the G code list the command is continuously valid in the next block until another code in the same group is directed.

2) Being from different groups, even several G codes can be commanded in the same block.

3) When more than 2 of G codes from the same group are commanded in the same block, the finally commanded G code is valid.

4) If ONE SHOT code and MODAL code are commanded in the same block, MODAL code is ignored and ONE SHOT code is valid.

5) Each of G code is available only for the applicable function.

6) Where there is no function applied to the G code commanded, the alarm is indicated.

7) The status of the modal G functions are as indicated below when the power is turned ON.

G ROUP	G Function	Remarks
01	G00	Positioning (Rapid traverse)
04	G69	Opposed tool post(Mirror) image [Off]
07	G40	Cancel of tool nose R compensation
09	G22, G23	Stored stroke limit function [ON],[OFF]
12	G67	Cancel of macro modal call
14	G54	Selection of work coordinate system 1
16	G18	Z, X plane selection

3. Feed function

• G00

In case of the absolute coordinates command, the tool moves at the rapid traverse speed to the position commanded on the basis of the original processing point, and in case of the incremental value command, to the point as far as the value commanded from the present position

This can be used in the same block together with that of M / S / T code, paying attention to the interference with tail stock, works and chuck.

X / Z and U / W are available at the same time.

```
G00 X(U)__ Z(W)__;
G00 X(U)__ Z(W)__ M__;
```

- G01

Cutting feed to the commanded point is carried out at the commanded feed along the straight line. The same feed is not needed to be commanded repeatedly as the commanded feed is continuously valid.

Where the feed has never been commanded, the feed is "0".

```
G01 X(U)__ Z(W)__ F__;
G01 B__F__;
```

OBSERVANCE

- The FEED command, without the Milling function is the feed per rotation (G99).
- For the feed of Milling processing, use the feed per minute (G98).

- G02(CW)

This commands the circular arc processing of CW direction.

```
G02 X(U)__ Z(W)__ R__ F__;
G02 X(U)__ Z(W)__ I__ K__ F__;
```

- G03(CCW)

This commands the circular arc processing of CCW direction.

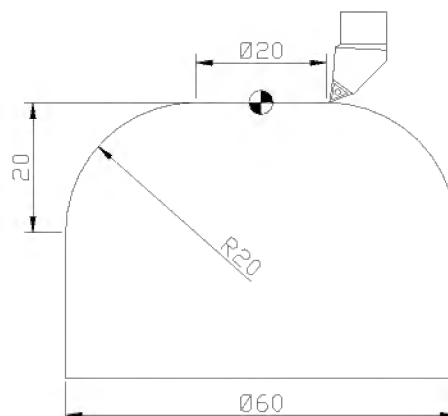
```
G03 X(U)__ Z(W)__ R__ F__;
G03 X(U)__ Z(W)__ I__ K__ F__;
```

X, Z : Coordinates of the end point of circular arc processing.

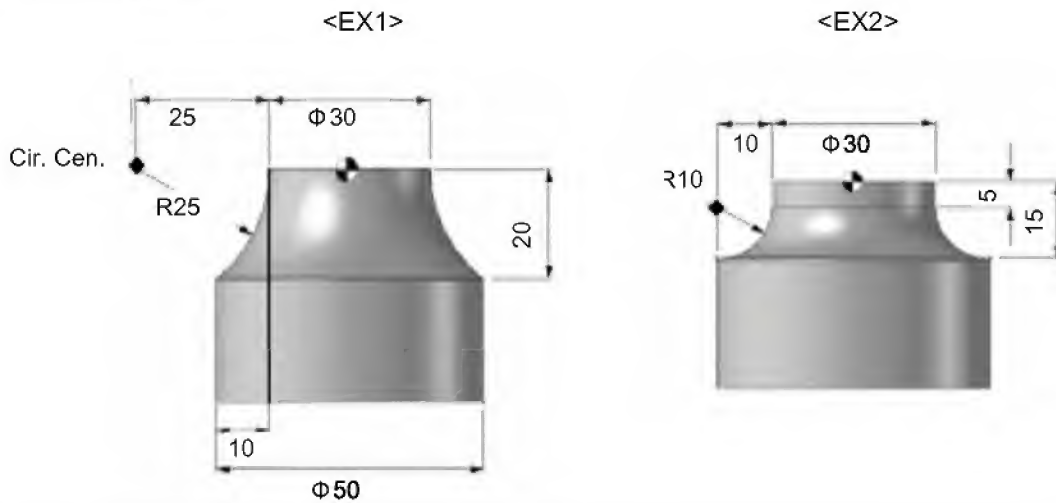
U,W: Distance from the start point of circular arc processing to the end point of it.

I, K : Distance from the circular arc start point to the circular arc center.

R : Radius of the circular arc.



<Program example>



Exercise 1	
When R is commanded	When I, K are commanded
N1 G28 U0. W0.; T0101; G50 S1300 M08; G00 G42 X30. Z2.; G96 S200 M03; G01 Z0. F0.3; G02 X50. Z-20. R25.; G00 G40 W3.; G28 U0. W0. M05; M30;	N1 G28 U0. W0.; T0101; G50 S1300 M08; G00 G42 X30. Z2.; G96 S200 M03; G01 Z0. F0.3; G02 X50. Z-20. I-25.; G00 G40 W3.; G28 U0. W0. M05; M30;

Exercise 2	
When R is commanded	When I, K are commanded
N1 G28 U0. W0.; T0101; G50 S1300 M08; G00 G42 X30. Z2.; G96 S200 M03; G01 Z-5. F0.3; G02 X50. Z-15. R10.; G00 G40 W3.; G28 U0. W0. M05; M30;	N1 G28 U0. W0.; T0101; G50 S1300 M08; G00 G42 X30. Z2.; G96 S200 M03; G01 Z-5. F0.3; G02 X50. Z-15. I-10. R10.; G00 G40 W3.; G28 U0. W0. M05; M30;

• G04(DWELL)

This commands the temporary stop of program for the specified time.

G04 X1. To stop for 1 sec.

U1.

P1000

- G28(automatic zero return)

This commands the automatic zero return of turret.

G28 U0. W0: G28 U0. W0.; (Return to the zero point rapidly)

G28 B0 : G28 U0. W0. B0.:

G28 X200. Z250 : (Return to the zero point through X200./Z250.)

4. Setup of spindle speed

- G50(Setup of coordinate system and the maximum spindle speed)

The maximum spindle speed of the main/sub spindle can be limited by the following commands in the case of the constant surface speed control.

G50 command is needed to be directed before the constant surface speed(cutting speed) control (G96) is executed.

S function meaning cutting speed cannot be commanded in the block of G50.

G50 S ;
 Maximum spindle speed(rpm)

G96 S____; _____ Circumferential speed(cutting speed m/min)

- G96(Activation of constant surface speed control)

- G97(Deactivation of constant surface speed control)

When the cutting speed (circumferential speed m/min or feet/min) is directly commanded by S function, the number of spindle rotation is continuously controlled so that the cutting speed can become constant for change of tool position (diameter of workpiece).

The relation between the cutting speed and the spindle speed is as the following fomula.

V = cutting speed(m/min)

$$D = \text{diameter of workpiece(mm)} \quad \frac{1,000 \times V}{\pi \times D}$$

N = spindle speed(rpm)

1) Activation/deactivation of the constant surface speed control.

- G96 : The constant surface speed control is activated.
- G97 : The constant surface speed control is deactivated. → Constant spindle speed

2) Cutting speed command

Specify the cutting speed with an address S and following four digits.

Input unit (Metric) \Rightarrow m/min

Input unit (Inch) \Rightarrow feet/min

- ▶ When the constant surface speed control is not used(G97), the four digits following an address S command the spindle speed.
- ▶ When the constant surface speed control is being executed, the spindle speed is

clamped at the setting by G50 even if it's calculated to be faster than the setting by G50.

- ▶ Since the constant surface speed control assumes that the commanded X coordinate value indicates the correct diameter of the workpiece, set the coordinate system(G50) so that the spindle center makes X=0.
- ▶ The surface speed commanded in the constant surface speed control is the surface speed against the programmed path. It's not against the position with the tool offset value added.
- ▶ The constant surface speed control can be done in the negative region of the X coordinate.
- ▶ If the constant surface speed control is executed with the MACHINE LOCK switch on, the spindle speed changes even if the machine does not move
- ▶ An S value commanded in the G96 mode is maintained after the mode is changed to G97 and is restored when the G96 mode is reactivated.
- ▶ When the mode is changed from G96 to G97, if an S(rpm)command is not given in the G97 mode, the last speed in the G96 mode is used as the S command for the G97 mode.

Consequently, the spindle speed does not change when the mode is changed from G96 to G97.

- ▶ In a rapid traverse block in which G00 is commanded, the constant surface speed control does not calculate the surface speed from moment to moment according to the positional change of the tool, but calculates the surface speed according to the final position of the block. Besides, because the output nature of spindle motor is involved in, select the optimal range of speed according to the size and cutting speed of workpiece.

Constant cutting speed control

·G50 S1900 * The spindle speed set to 1,900rpm

·G96 S120 * Constant surface speed(cutting speed) set to 120m/min(constant surface speed control)

Constant spindle speed control

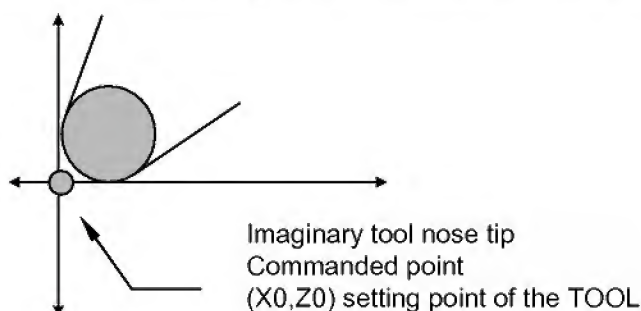
·G97 S1000 * Constant spindle speed set to 1,000rpm.

5. Compensation function

• Imaginary tool nose tip

Imaginary tool nose tips, even though they don't actually exist because the tool nose is round-shaped, are the random points set by the programmer for easy programming.

In case of horizontal and vertical line, the commanded points (imaginary tool nose tips) are fitted to the real processing point, however, the programmed tips are not for the taper and circular arc processing so that this error should be compensated.



1) X axis processing (Path No.1)

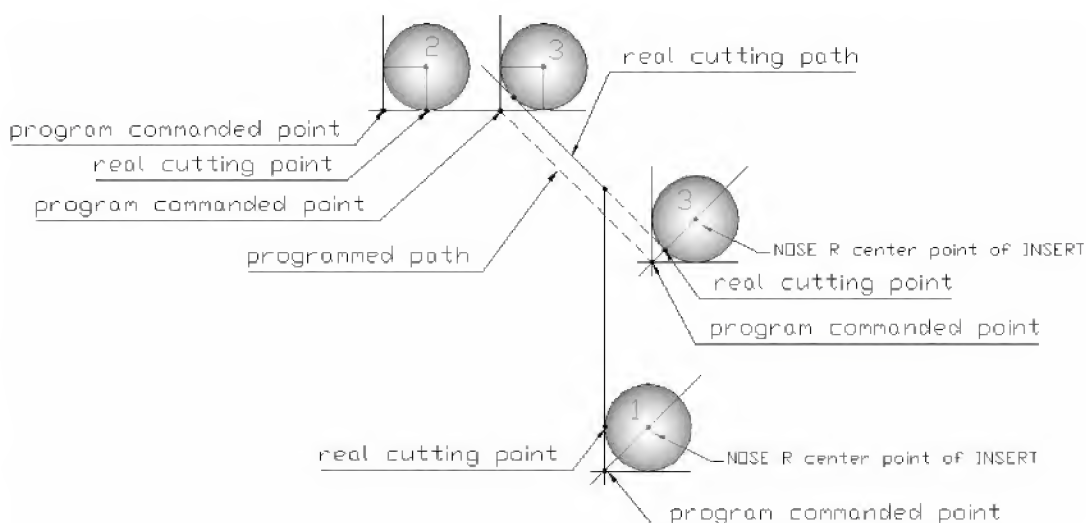
Compensation is not needed because the programmed path is the same as the insert processing path, when only X axis moves.

2) Z axis processing (Path No.2)

Compensation is not needed because the programmed path is the same as the insert processing path, when only Z axis moves.

3) Taper, circular arc processing (Path No.3)

Compensation is needed because there are differences as the following between the programmed the real processing path when X axis and Z axis move at the same time.



- Tool Nose Radius Compensation

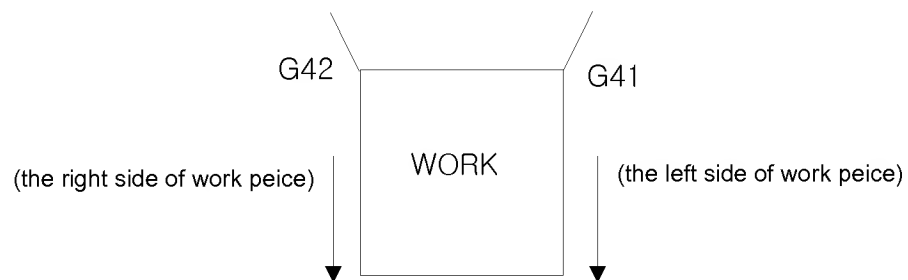
A programmer makes out the commands with imaginary tool nose tip, but the tool noses are round-shaped. So the errors of tool position in case of taper cutting or circular arc cutting are automatically compensated

For End mill, tool nose R compensation might mean the slight compensation of end mill.

1) G41 : When a material is on the right of the tool moving direction.

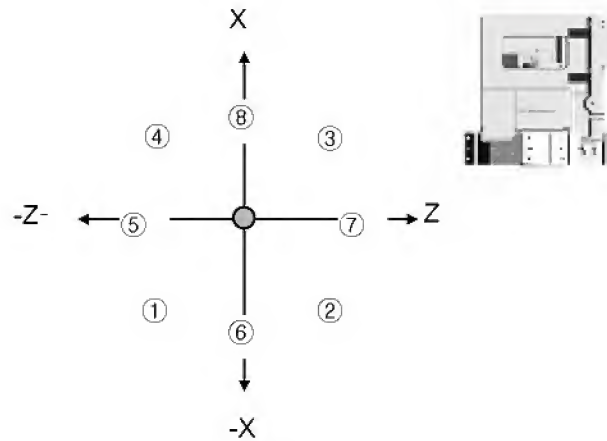
2) G42 : When a material is on the left of the tool moving direction.

3) G40 : When the tool nose R compensation is cancelled.



- The number of imaginary tool nose tip

The processing direction should be previously input for the automatic tool nose R compensation.



If the standard tools are used, the numbers of tool nose tips are as the following.

Classification	OD	ID	THREAD	U-drill	OD Groove	ID Groove	Back OD	Back ID
Main spindle processing	3	2	8	7	8	6	4	1

OBSERVANCE

- 1) The block G41 or G42 is commanded in G 40 mode for the first time is the start up block where the center of tool nose R is located rectangular to the block.
- 2) Do not command G41 during G41 mode.
Do not command G42 during G42 mode.
- 3) Tool nose R compensation should be started or finished with G00 or G01, not with G02 and G03 at the same time.
- 4) The completion of G41 or G42 should be done in the cancel mode(G40).

6. OFFSET / Imaginary tool nose tip No. / Tool nose R compensation amount input of each spindle

- OFFSET value input

- 1) Press the OFFSET SETTING key.
- 2) Press the [OFFSET]key.
- 3) Press the [WEAR] key.
- 4) X/Z is the offset value of tool position, R is the tool nose R compensation and T is the tool nose.
- 5) Move the cursor to the X-axis of the relevant tool number and input the offset value.
- 6) When pressing the [+INPUT] among the soft keys, the incremental value of compensation is input and pressing the [INPUT], the entered value is input as it is. (X-axis is the diameter value.)
- 7) For Z-axis, the same way is used.

- Tool nose R compensation among input

Move the cursor to the R of corresponded tool No.

Press INPUT key after only the numerical value of nose R of insert tip is input.

See the standard of tip for the NOSE R values.

- Tool nose number input

Move the cursor to the T of the relevant tool number.

Press the INPUT key after the tool nose number set according to the machining direction of the tool to be used.

7. Thread cutting

- Spindle speed limit during thread cutting

Specify spindle speed and thread lead as the following.

$$L \leq \frac{1200}{R} \quad \begin{array}{l} L : \text{Thread lead} \\ R : \text{Spindle speed} \end{array}$$

- Incomplete thread part

During thread cutting, a thread part without any regular lead(pitch) comes about at the beginning and ending part of thread cutting. This is called incomplete thread part, which is obtained through the following fomula.

- Beginning part $\delta 1$

$$\delta 1 = \delta 2 \times C$$

- Ending part $\delta 1$

$$\delta 1 = \frac{L \times R}{1800} \quad \begin{array}{l} L : \text{Thread lead} \\ R : \text{Spindle speed} \end{array}$$

A	C(constant)
0.005	4.298
0.010	3.605
0.015	3.200
0.020	2.912

* A : Allowable error of thread

- G32

This is infrequently used because the program might be inconveniently lengthened, although straight, taper or face thread processing is possible.



Material : S45C
Cutting speed : 100 m/min
Accuracy : 0.01

1) Spindle speed

$$\frac{V \times 1000}{D \times \pi} = \frac{100 \times 1000}{50 \times 3.14} = 636.9 \approx 640 \text{ rpm}$$

2) Incomplete thread $\delta 1$, $\delta 2$

$$\delta 1 = \frac{1.5 \times 640}{1800} \approx 0.533 \rightarrow \text{programmed to 1mm}$$

$$\delta 1 = 0.533 \times 3.605 \approx 1.95 \rightarrow \text{programmed to 2mm}$$

3) The number of cut is calculated according to the pitches on the thread cutting table. 5 times.

4) Program

```
O0001;
N1 G28 U0. W0.;      G32 Z-26.;
T0404;               G00 X55. M09;
G97 S640 M03;        G28 U0. W0.
M05;
X49.3 Z2. M08;        M30;
G32 Z-26. F1.5;
G00 X55.;
Z2.;
X48.9;
G32 Z-26.;
G00 X55.;
Z2.;
X48.5;
G32 Z-26.;
G00 X55.;
Z2.;
X48.24;
G32 Z-26.;
G00 X55.;
Z2.;
X48.04;
```

	Diameter	X value
1	0.35	49.30
2	0.20	48.90
3	0.20	48.50
4	0.13	48.24
5	0.10	48.04

- G92

Straight and taper thread cutting program can be simply formed and the chamfering function of threading-up part is available.

G92 X 1st Z①___ R②___ F③___;

X 2nd;

X 3rd;

.

.

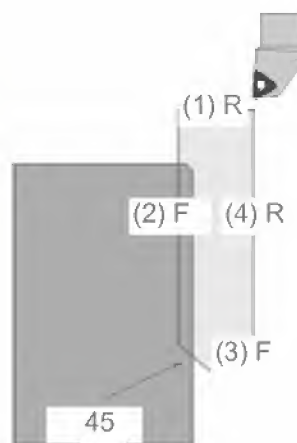
.

① : Length of thread cutting

② : Pitch value in case of taper thread

③ : Thread lead

X : The number of cut is calculated according to the pitches on the thread cutting table, and the value calculated from the formula, workpiece diameter minus amount of cut $\times 2$ is commanded.



< Program example >



```
O0001;
N1 G28 U0. W0.;
G97 S640 T0404 M03;
G00 X55. Z2. M08;
G92 X49.3 Z-26. F1.5;
X48.9;
X48.5;
X48.24;
X48.04;
G28 U0. W0. M05;
M30;
```



PT 11/4(11 threads)

PITCH = 2.30909 mm

Cutting speed V=100 m/min

Height of thread \approx 1.48

Number of cut = 7 times

```

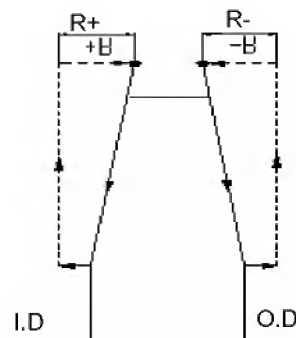
O0001;
N1 G28 U0. W0.;
G97 S750 T0404 M03;
G00 X55. Z8.5 M08;
G92 X41.86 Z-23.5 R-1. F2.309;
X41.26;
X40.76;
X40.36;
X39.80;
X39.60
G28 U0. W0. M05;
M30;
  
```

	Cut	X value
1	0.35	41.86
2	0.30	41.26
3	0.25	40.76
4	0.20	40.36
5	0.15	40.06
6	0.13	39.80
7	0.10	39.60

- Pitch value R

A half(radius value) of the difference of X values at the beginning point and ending point of thread cutting is commanded.

The marks are on the right.



OBSERVANCE

- 1) FEED OVERRIDE switch is invalid for thread cutting.
- 2) For thread cutting, command G97 so that the spindle speed would be constant.
- 3) For thread cutting, the feed by G98(feed per minute, mm/min) is impossible.
- 4) Thread chamfering is unavailable in G32 thread cutting.
- 5) If chamfering is unnecessary for G92 thread cutting, it can be cancelled with M52.
- 6) Chamfering value is based on the length of thread lead.

• G76

G76 P①___ Q②___ R③___;

G76 X④___ Z⑤___ P⑥___ Q⑦___ R⑧___ F⑨___;

P① : The form of P030060 is commanded.

P03___ : Number of facing repeat

P___00___ : Chamfering amount

P___60 : Degree of thread(80°, 60°, 55°, 30°, 29°, 0°)

Q② : Least amount of cut(Radius value is commanded.)

R③ : Facing allowance

X④ : Depth of thread(Diameter value)

Dimension of thread – Pitch×H(in case of meter thread:0.6495)×2

Z⑤ : Length of thread cutting

P⑥ : Height of thread(radius value)

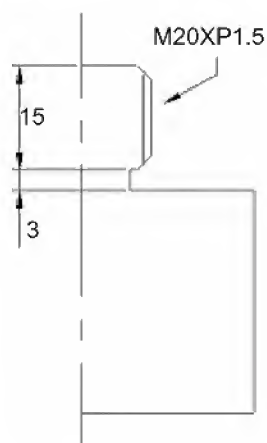
Pitch x H

Q⑦ : Initial amount of cut

R⑧ : Taper value of thread(omitted in case of straight thread)

F⑨ : Thread lead

< Thread cutting program example >



O0001;
N1 G28 U0. W0.;
T0101;
G97 S900 M08;
G00 X25. Z0. M03;
G92 X19.3 Z-12. F1.5;
X18.9;
X18.5;
X18.24;
X18.04;
G28 U0. W0. M05;
M09;
M30;

T0101;
N1 G28 U0. W0.;
T0101;
G97 S900 M08;
G00 X25. Z3. M03;
G76 P030060 Q300 R300 ;
G76 X17.402 Z-10. P1299 Q300 F1.5.;
G28 U0. W0. M09;
M30;

[illegible]

Depth of cut	
METER thread	$H=0.6495P$
WEETWORTH thread	$H=0.6403P$
UNIFIED thread	$H=0.6134P$
PIPE thread	$H=0.6403P$

OBSERVANCE

* The amount of cut, with mark, is for a single axis, so the diameter value calculated should be input.

8. Composite fixed cycle

- G71(OD roughing cycle)

G71 U___ R___;

G71 P___ Q___ U___ W___ F___;

N①;

N②;

N③;

N④;

N⑤;

N⑥;

N⑦;

N⑧;

N⑨;

N⑩;

N⑪;

N⑫;

N⑬;

N⑭;

N⑮;

N⑯;

N⑰;

N⑱;

N⑲;

N⑳;

N㉑;

N㉒;

N㉓;

N㉔;

N㉕;

N㉖;

N㉗;

N㉘;

N㉙;

N㉚;

Facing shape is programmed.

This is commanded without any mark and same as the radius value.

R : Amount of escape

This is the amount of escape from the processing face to return to the initial point for the next cycle, after a cycle is.

P : The same number as N① of the first block in which the facing shape has been programmed.

Q : The same number as N② of the last block in which the facing shape has been programmed.

U : X axis facing allowance

A diameter value is commanded, and OD is (+) and ID is (-) in case of general processing.

W : Z axis facing allowance

F : Feed in case of roughing

- G70(OD facing cycle)

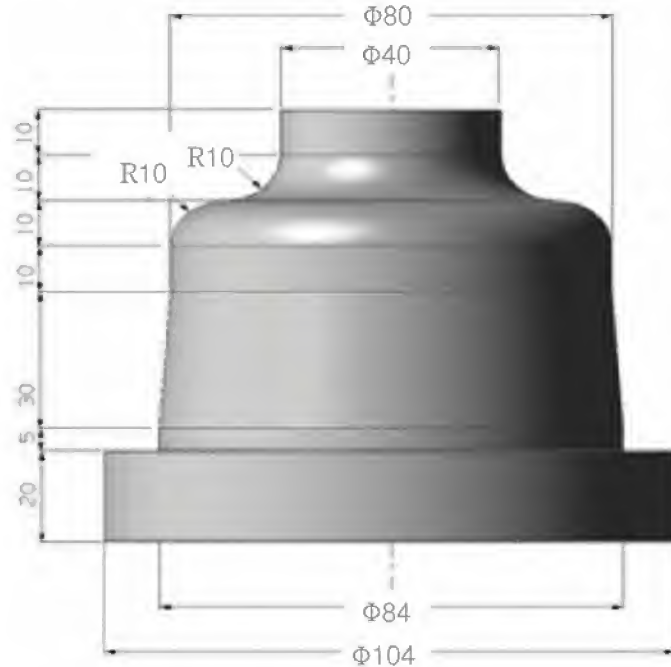
G70 P___ Q___;

P : The command is same as the number of P in G71 Cycle.

Q : The command is same as the number of Q in G71 Cycle.

- 1) In the block in which the composite fixed cycle is commanded, the parameters including P, Q, X, Z, U, W, R should be properly commanded for each block..
- 2) In the block of sequence number specified as P in G71, G00 or G01 of G code in the group 01 should necessarily be commanded.
- 3) The followings cannot be commanded in the block in which G70 and G71 have been commanded and the one between the sequence numbers specified as P and Q of G70 and G71.

- One Shot G Codes except Dwell(G04)
- G Code of Group 01 except G00, G01, G02, G03
- G Code of Group 06



Works : $\varnothing 110 \times L100$
 Material : S45C
 Roughing : $V=200$
 m/min

Facing : $F=0.3$ mm/rev
 $V=220$ m/min
 $F=0.15$ mm/rev

O0001;
 N1 G28 U0. W0.;
 T0101;
 G50 S2000 M08;
 X114. Z0.;
 G96 S180 M03;
 G01 X-0.5 F0.3;
 G00 X110. Z2.;
 G71 U3. R1.;
 G71 P100 Q200 U1.5 W0.05 F0.3;
 N100 G42 X104.;
 G01 X40. Z-1. F0.15;
 Z-10.;
 G02 X60. Z-20. R10.;
 G03 X80. Z-30. R10.;
 G01 Z-40.
 X84. Z-70.;
 Z-75.;
 X102.;
 X106. Z-77.;
 N200 G00 G40 W3.;
 G28 U0. W0. M05;
 M01;

N2 G28 U0. W0.;
 T0202;
 G50 S2500 M08;
 X44. Z0.;
 G96 S220 M03;
 G01 X-0.5 F0.15;
 G00 X110. Z2.;
 G70 P100 Q200;
 G28 U0. W0. M05;
 M30;

- G74(PECK DRILLING Cycle)

This cycle is used to make the chip disposition in case of facing, single grooving or cutting easier.

In addition, if X(U) and P are omitted, only Z axis works and then, peck drill cycle gets available.

G74 R① ;

G74 X(U)② Z(W)③ P④ Q⑤ R⑥ F⑦;

① : Amount of regression

(Cutting is done as much as the amount specified as Q, and regression is done as much as ① , which are repeated until the dimension of X is attained.)

② : Processing coordinates X axis

③ : Depth of cut to Z axis direction

④ : Amount of movement to X axis direction

⑤ : Amount of cut to Z axis direction(Radius value is commanded)

⑥ : Amount of tool escape at the bottom point of cut (The direction of escape is X axis direction.)

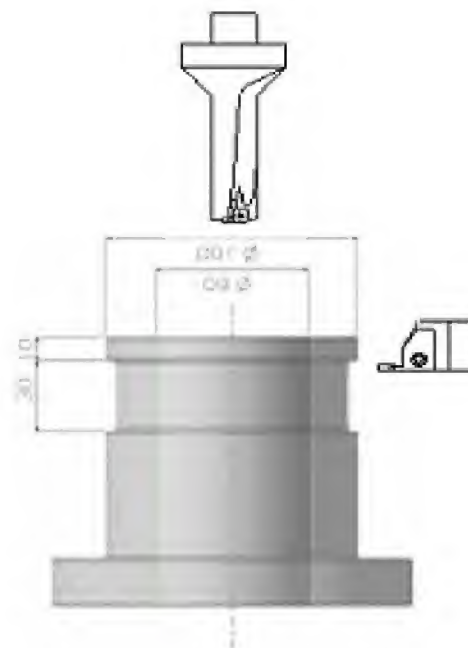
⑦ : Feeding speed

< Program example >

```

N1 G28 U0. W0.;
T0101;
G97 S1100 M03;
X0. Z5.;
G74 R1.
G74 Z-103. Q5000 F0.1;
G28 U0. W0. M05;
M01;
N2 G28 U0. W0.;
T0202;
G97 S1200 M03;
X104. Z-13.;
G75 R1.;
G75 X92. Z-40. P2500 Q3000 F0.12;
G28 U0. W0. M09;
M05
M30;

```



OBSERVANCE

- 1) Decimal point cannot be input for the value of P and Q. (Input P3000 if the dimension is 3mm)
- 2) Be cautious of the interference with workpiece because the value of R⑤ creates escape at the bottom point of cut rectangular with the direction of cut.
 - G75(OD PECK DRILLING cycle)

This is the same as that only X and Z are replaced in G74 cycle.

 - ① : Amount of regression

(Cutting is done as much as the amount specified as P, and regression is done as much as ①, which are repeated until the dimension of X is attained.)
 - ② : Groove bottom coordinate of X axis
 - ③ : Total processed length to Z axis direction
 - ④ : Amount of cut to X axis direction (Radius value is commanded)
 - ⑤ : Amount of movement to Z axis direction
 - ⑥ : Amount of tool escape at the bottom point of cut (The direction of escape is Z axis direction.)
 - ⑦ : Feeding speed

3.3 G Code

- The following G codes are available when the functions applied to G code are included into the machine body.

G code	Group	Function
G00	01	Positioning (Rapid traverse)
G01		Linear interpolation (cutting feed)
G02		Circular interpolation CW
G03		Circular interpolation CCW
G04	00	Dwell
G10		Programmable data input
G11		Programmable data input cancel
G18	16	Zp Xp plane selection
G20	06	Input in inch
G21		Input in mm
G22	09	Stored stroke check function on
G23		Stored stroke check function off
G27	00	Reference position return check
G28		Return to reference position
G30		Return to the 2nd, 3rd, 4th reference point
G31		Skip function
G32		Thread cutting
G40	07	Cancel of tool nose R compensation
G41		Tool nose R compensation, Left-side
G42		Tool nose R compensation, Right-side
G50	00	Coordinate system setting or max. spindle speed setting
G50.3		Workpiece coordinate system preset
G52	00	Local coordinate system setting
G53		Machine coordinate system setting
G54	14	Workpiece coordinate system 1 selection
G55		Workpiece coordinate system 2 selection
G56		Workpiece coordinate system 3selection
G57		Workpiece coordinate system 4selection
G58		Workpiece coordinate system 5 selection
G59		Workpiece coordinate system 6 selection
G65	00	Macro calling
G66	12	Macro modal call
G67		Macro modal call cancel
G70	00	Finishing cycle

G code	Group	Function
G71		Outer diameter roughing cycle
G72		End face roughing cycle
G73		Pattern repeating cycle
G74		End face peck drilling
G75		Outer diameter, internal diameter drilling
G76		Multiple Threading cycle
G90	01	Outer diameter, internal diameter cutting cycle
G92		Thread cutting cycle
G94		End Face turning cycle
G96	02	Constant surface speed control
G97		Constant surface speed control cancel
G98	05	Per minute feed (mm/min)
G99		Per revolution feed (mm/rev)

3.4 M Code

- The following M codes are available when the functions applied to M code are included into the machine body.

M code	Function	PUMA VT900	PUMA VT900M
M00	Program Stop	●	●
M01	Optional Stop	●	●
M02	End of Program	●	●
M03	Main Spindle motor CW	●	●
M04	Main Spindle motor CCW	●	●
M05	Main Spindle motor Stop	●	●
M06			
M07	Coolant Flushing Motor ON	●	●
M08	Coolant Motor ON	●	●
M09	Coolant Motor OFF	●	●
M10			
M11			
M12	Chuck Shower Motor ON	●	●
M13	Chuck Shower Motor OFF	●	●
M14	Chip Air Blow ON & Inching command	○	○
M15	Chip Air Blow OFF & Inching cancel command	○	○
M16			
M17	Machine Lock Activate Command	●	●

M code	Function	PUMA VT900	PUMA VT900M
M18	Machine Lock Cancel Command	●	●
M19	Spindle Orientation Command	○	○
M20			
M21	Optional Block Skip On	○	○
M22	Optional Block Skip Cancel	○	○
M23	Program Start Check	●	●
M24	Chip Conveyor Motor On command	●	●
M25	Chip Conveyor Motor Off command	●	●
M26	Straddle Tool Action command	○	○
M27	Straddle Tool Action cancel	○	○
M29	Rigid Tap Mode Command	○	
M30	Reset & Rewind(return to the top block of Program)	●	●
M31	Spindle Interlock bypass	●	●
M33	Revolving Spindle(Tool) CW command		●
M34	Revolving Spindle(Tool) CCW command		●
M35	Revolving Spindle(Tool) Stop command		●
M41	Spindle Low Gear command	●	●
M42	Spindle High Gear command	●	●
M52	Automatic Splash Guard door Close command	○	○
M53	Automatic Splash Guard door Open command	○	○
M54	Part Counter Up	●	●
M55	Restart Program after M02/M30	●	●
M56	Tapping Mode Select	●	●
M57	Tapping Mode Cancel	●	●
M58			
M59			
M60	Tool Index & Axis Move Command	●	
M61	Switching Low Speed		
M62	Switching High Speed		
M63	Spindle CW & Coolant ON Command		
M64	Spindle CCW & Coolant ON Command	●	●
M65	Spindle Stop & Coolant OFF Command	●	●
M66	Chuck Pressure Low command	○	○
M67	Chuck Pressure High command	○	○
M68	Chuck Close command	●	●
M69	Chuck Open command	●	●

M code	Function	PUMA VT900	PUMA VT900M
M70			
M71			
M72	Spindle Reverse Direction Rotation	●	●
M73	Spindle Normal Direction Rotation	●	●
M74	Error Detect On	●	●
M75	Error Detect Off	●	●
M76	Chamfering On	●	●
M77	Chamfering Off	●	●
M84	Turret CW Direction Rotation	●	
M85	Turret CCW Direction Rotation	●	
M88	C-axis Hyd. Brake Pressure Low Mode On		●
M89	C-axis Hyd. Brake Pressure High Mode On		●
M90	C-axis Hyd. Brake Pressure Mode Off		●
M91	External M91	○	○
M92	External M92	○	○
M93	External M93	○	○
M94	External M94	○	○
M98	Sub Program Access	●	●
M99	End of Sub Program or Continuous Cycling	●	●
M121	Center Coolant A On		
M122	Center Coolant B On		
M123	Center Coolant C On		
M124	Center Coolant Off		
M191	PMC-Axis Control On (Normal Turret Mode)		●
M192	PMC-Axis Control Off (Easy Tap with Macro mode)		●

3.5 S Code

- Spindle speed command

- 1) Command the spindle speed directly with an address and following four digits in MDI mode.
- 2) Rotate the spindle with the commands of M03 and M04 in MDI mode.
(At this time, the spindle rotates at the speed commanded in ①.)
- 3) After completing ①) and ②), the main/sub spindle speed can be altered by changing S function command.
- 4) To stop the spindle rotation, command a M05.

At this time, although the spindle is stopped, since the S function command is effective, if M03/M04 is commanded to rotate the spindle again, the main/sub spindle rotates at the previous speed.

OBSERVANCE

- 1) To rotate the spindle for the first time, follow the procedures ① → ② in order.
- 2) If the change of rotation direction during main/sub spindle rotation is commanded, the spindle stops then, change the direction of rotation.
- 3) Even if a command is given surpassing the maximum speed, the main/sub spindle rotates at the maximum speed and the automatic cycle continues. (But, if the maximum spindle speed has been commanded in 50 the spindle rotates at the commanded speed.)
- 4) The spindle speed is displayed at the lower right corner of the LCD.
- 5) Since the output of the spindle motor is limited according to the spindle speed, use it efficiently referring to the main spindle output chart.
- 6) When the constant surface speed control is not used(G96), a movement command and a S function in the same block are executed at the same time.
- 7) If the spindle is started with M03/ the next block is executed after the commanded speed is almost reached.
- 8) Since changing the speed only with a S command does not confirm that the speed is reached, include M03/M04 in the same block as the S function to make the speed8)

3.6 T Code

Command the selection of tool and offset number of tool position with T+3 digits or T+4 digits.

1) T 3 digits command

T 00 _____ Offset number command(0-9)
 |
 └──────────────── Tool number command(1-8)

2) T 4 digits command

T 00 _____ Offset number command(0-16)
 |
 └──────────────── Tool number command(1-8)

3) Command for tool position offset No.

If the offset No is commanded in MDI mode, the coordinate system is shifted as much as the amount of offset (GEOM, WEAR).

< WEAR offset is cancelled in the following cases >

OBSERVANCE

- 1) When all the axis are manually return to the zero position(not in MDI mode.)
- 2) When the system is reset
- 3) When tool offset number 0 or 00 is commanded

► GEOMETRY OFFSET is not cancelled.

● Tool offset value

The offset value can be set to the following values.

Metric input	0 - ± 999.999 mm
Inch input	0 - ± 99.9999 Inch

OBSERVANCE

- 1) T+3 digits and T+4 digits can be changed by the parameter, the standard is set to T+4 digits .
- 2) If T commands are programmed in the same block with feed command, both will be executed simultaneously.
- 3) Be sure not to program a T command in the same block as an arc interpolation (G02, G03).
- 4) Turret indexing is performed in CW/CCW direction according to the closest path.
- 5) Offset cancel (T00) and offset command cannot be commanded as a continuous block.

4. Coordinate system

4.1 Geometry Coordinate System

The coordinate system for each tool is set with geometry offset.

<Z axis>

- 1) Press G97M03S400 in MDI mode, and then press the INSERT key for input.
- 2) Press the CYCLE START.
- 3) Select the MANUAL mode and press the PULSE HANDLE X button.
- 4) After pressing the POS. button, press the soft key under the LCD to find the relative coordinates(U/W).
- 5) Get Z axis and X axis closer to the surface of workpiece at PULSE HANDLE $\times 100$.
- 6) Confirm the CW and CCW according to the direction of tool insert attached and press the SPINDLE (CW/CCW) button on the control panel.
- 7) Get the tool closer to Z axis and touched to the workpiece at PULSE HANDLE $\times 1$.
- 8) The coordinates of W will be 0 if the ORIGIN soft key is pressed while W pressed is flickering.
- 9) Select Z axis, press X10 button then move the tool to the position of workpiece, X+.
- 10) After moving the coordinates of W by $-0.5 \sim -1.0$, the surface of works is manually processed to the direction of X at $\times 10$. Moving direction is X+.
- 11) Press the SPINDLE STOP button confirming the surface of workpiece, and repeat the above manually until the surface of works is completely finished.
- 12) If the workpiece, after confirming, is completely finished, press the OFFSET SETTING button on the right side of LCD, then the OFFSET key in the lower part of LCD, and finally the GEOM key.
- 13) After moving the cursor to Z having the same number as the tool number, if Z0 is input and the MEASURE among the soft keys on the bottom of LCD is pressed, the distance from zero position to the initial processing point of Z axis.

< X axis>

- 1) Move the tool to Z- and X+ and place it on workpiece.
- 2) As in Z axis, get the tool touched onto the surface of X axis and then move it to the direction of Z+ out of the workpiece. After pressing U, press the ORIGIN so that the relative coordinates might become 0 and move X axis by -1~-2.
- 3) Select $\times 10$ to the direction of Z- and move the tool so that the surface of works might be manually processed. Move the tool to the direction of Z+ out of the workpiece.
- 4) Press the SPINDLE STOP button and confirm that the surface of workpiece has been processed. If the surface exceeds the radius after the above repeated procedure, find out the GEOMETRY display and move the cursor to the X axis of tool number as in Z axis.
- 5) After the diameter of workpiece is measured and X \emptyset is input, if the MEASURE is pressed, the distance from the zero position to the initial processing position of X axis of workpiece is input.
- 6) Each of the following tool finds out the OFFSET display while touched to Z/X axis and sets the coordinate system in the same way.

OBSERVANCE

- 1) Confirm zero return before setting the coordinate system.
- 2) G97 should be confirmed before the rotation of main spindle.
When G96 is set, the main spindle rotates at high speed.
- 3) When the tool is touched onto the workpiece, be sure to confirm rotating direction, set the PULSE HANDLE to X1, and move the tool considering the direction of X/Z axis.

4.2 G50 Coordinate system

For G50 coordinate system, the distance from zero position to the initial processing point is directly programmed in G50.

<Setting method >

- 1) Decide the reference tool(The first tool on the program)
- 2) As in the GEOMETRY coordinate system, repeat the procedures that the surface of works of Z axis is manually processed using the reference tool. Do not change the coordinate of W which was set to 0 after the last processing.
- 3) For X axis, manual processing procedure is repeated and U is set to 0 at the final processing.
- 4) If the main spindle is erected and zero returning is executed, the distances from the zero position to the initial processing position for Z-axis , and to the X axis surface of workpiece for X axis are displayed as U/W.
- 5) Select the EDIT mode and find out the program entered to input followings in the block of G50 .

G50 X___ Z___ S___ M08 :_

X value : U value plus the diameter of workpiece set.

Z value : W value input

- 6) Select the MDI mode and press the CYCLE START button after G50 X___ Z___;is input on the program.
- 7) For the following tool, as in the GEOMETRY coordinate system, find out the GEOMETRY display after Z/X axis is touched and move the cursor to the axis corresponded to the applicable tool No. Then, if the diameter of Z0. / X workpiece is input and the MEASURE button is pressed, the difference of X/Z length between the reference tool and the setting tool is input in each axis.
- 8) For all of the tool, the same procedures as in ⑦are applied.
- 9) When the workpiece is exchanged, only the Z axis of reference tool is set, which is programmed in G50.


OBSERVANCE

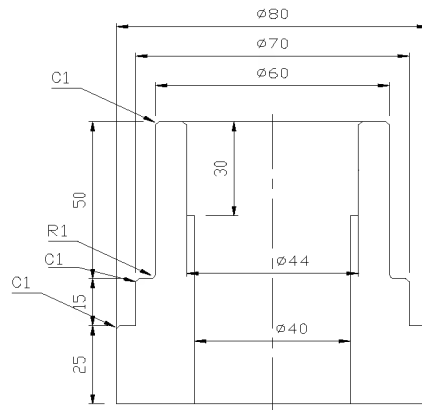
- 1) Do not command T code in the same block when G50 coordinate system is used.
- 2) Do not command offset cancel and offset call as continued blocks.

4.3 Work shift Coordinate system

The absolute coordinate system can be moved to the initial processing position by setting the distance to the initial processing position in the WORK SHIFT.

< Setting method>

- 1) Select the reference tool and get the tool touched onto the surface of workpiece to the direction of Z axis.
- 2) Press the OFFSET SETTING key, press  key among the soft keys and press the W.SHIFT key.
- 3) Move the cursor to the Z axis of MEASUREMENT.
- 4) Input 0 and press the INPUT key.
- 5) After X axis is touched, the same way is used to move the cursor to X axis. Then press the diameter of workpiece and press the INPUT key.
- 6) In X axis of the MEASUREMENT, the diameter of workpiece is input, and in Z axis, 0 is input.
- 7) In each axis of the SHIFT VALUE, the distance from the zero position to X0 /Z0 is input.
- 8) If zero returning is done, the absolute coordinate value of each axis becomes identical to the value input in each axis of the SHIFT VALUE.
- 9) Get every tool except the reference tool touched to the X/Z of applicable spindle and carry out the setting with the same way as in the GEOMETRY SETTING.
- 10) In the GEOMETRY OFFSET, the difference value of X/Z direction between each tool and the reference tool.
- 11) When the workpiece is exchanged, only the Z axis of reference tool is reset in the WORK SHIFT



N27 G00 Z2.;
N28 G00 G40 W3.;
N29 G28 U0. W0. M05;
N30 M30;

< U-Drill processing >

N2 Tool No.1 and offset(GEOM, WEAR) No.1call
N3 U-Drill positioning and coolant ON
N4 Constant spindle speed 1200rpm
N5 U-drill positioning
N6 U-Drill processing
N8 Zero return

< OD face cutting process >

N9 Tool No.2 and offset No. 2 call
N10 Maximum spindle speed 2200rpm
N11 Constant cutting speed 200m/min and spindle CCW rotation
N12 reverse Face cutting positioning
N13 Face cutting
N14 Chamfering position and tool nose R compensation
N15 Chamfering
N16 OD processing
N17 Escaping
N18 Tool nose R compensation cancel
N19 Spindle stop and zero return

< ID face cutting process >

N20 Tool No.4 and offset No.4 call
N21 Maximum spindle speed 2000rpm and coolant ON
N22 Constant cutting speed 190m/min and spindle CCW rotation
N23 Tool nose R compensation and positioning
N24 Chamfering
N25 ID processing
N26 Escape
N28 Tool nose R compensation cancel
N29 Spindle stop and zero return
N30 Program end

O0002;(2 process)
N1 G40 G28 U0.W0.;
N2 T0101;
N3 G50 1500 M08;
N4 G96 S180 M04;
N5 X104. Z2.;
N6 G01 X26. F0.3;
N7 G00 X100. Z2.;
N8 G71 U2.5. R2.;
N9 G71 P100 Q200 U1. W0.1 F0.3;
N100 G00 G42 X54.;
N10 G01 X60. Z-1.F0.15;
N11 Z-49.;
N12 G02 X62. Z-50. R1.;
N13 G01 X68.;
N14 X70. Z-51. ;
N15 Z-65.;
N16 X78.;
N17 X82. Z-66.;
N200 G00 G40 U2. W2. M09;
N18 G28 U0. W0. M05;
N19 M01;
N20 T0202;
N21 G50 S1500 M08;
N22 G96 S180 M04;
N23 X60. Z2.;
N24 G71 U2.5 R1.;
N25 G71 P300 Q400 U-1.5 W0.05 F0.25;
N300 G00 G41 X50;
N26 G01 X44. Z-1. F0.15;
N27 Z-30.;
N28 X40. ;
N29 Z-91.;
N400 G00 G40 U-2. W2. M09.;
N30 G28 U0. W0. M05;
N31 M01.;
N32 G28 U0. W0.;
N33 G00 T0303;
N34 G50 S1600 M08;
N35 G96 S200 M04;

N36 X100. Z0.
N37 G01 X40.F0.15;
N38 G00 X100. Z2.;
N39 G70 P100 Q200;
N40 G28 U0. W0. M09;
N41 M05;
N42 M01;
N43 T0303;
N44 G50 S1600 M08;
N45 G96 S200 M04;
N46 X60. Z2.;
N47 G70 P300 Q400;
N48 G28 U0. W0. M09;
N48 M05;
N49 M30

< O/D roughing process >

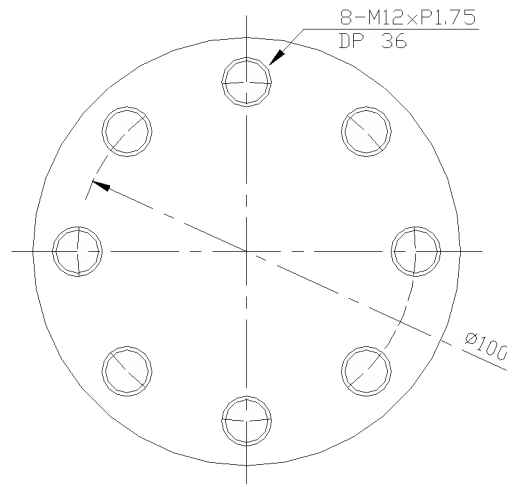
N2 Tool No.1and offset No.1 call
N3 Maximum spindle speed 1500rpm and coolant ON
N4 Constant cutting speed 180m/min and spindle CCW rotation
N5 Face cutting positioning
N6 Face cutting
N7 Cycle positioning->should be the same as the finishing cycle positioning
N8 O/D roughing cycle
N9 O/D roughing cycle
N100 Tool nose R compensation and finishing positioning
N10 finishing process pathway
N200 Tool nose R compensation cancel

< I/D roughing process >

N20 Tool No.2 and offset No.2 call
N21 Maximum spindle speed 1500rpm and coolant ON
N22 Constant cutting speed 180m/min and constant spindle CCW rotation
N23 Cycle positioning
N24 I/D roughing cycle
N25 I/D roughing cycle
N300 Tool nose R compensation and decision of chamfering positioning
N26 Finishing process pathway
N400 Tool nose R compensation cancel

< O/D finishing process >

- N33 Tool No.3 and offset No.3 call
- N34 Maximum spindle speed 1600rpm and coolant ON
- N35 Constant cutting speed 200m/min and spindle CCW rotation
- N36 Face cutting positioning
- N37 Face cutting
- N38 Cycle positioning -> should be the same as OD roughing cycle
- N39 O/D finishing cycle. The numbers of P. Q should be the same as OD roughing cycle.
- N42 Tool No.4 and offset No.4 call
- N43 Maximum spindle speed 1600rpm and coolant ON
- N45 Cycle positioning -> should be the same as ID roughing cycle.
- N46 Constant cutting speed 200m/min and spindle CCW rotation
- N47 ID facing cycle. The number of P,Q should be the same as ID roughing cycle.
- N48 End of program



5.2 MILLING Machining

O0001;

N1 G98 G28 U0. W0.(CENTER DRILL);

N2 T0101;

N3 X100. Z5.;

N4 M35;

N5 G28 C0;

N6 M33 S800;

N7 G83 H45. Z-7. R-1. Q10000 P300 F80. K8;

N8 G80;

N9 M35;

N10 G28 U0 W0;

N11 M01;

N12 T0202 (Φ10 DRILL);

N13 X100. Z5.;

N14 G28 C0.;

N15 M33 S1300;

N16 G83 H45. Z-40. R-3. Q20000 P1500 F130. K8;

N17 G80;

N18 M35;

N19 G28 U0 W0;

N20 M01;

N21 T0303(TAP M12);

N22 X100. Z5.;

N23 G28 C0.;

N24 M33 S300;

N25 M98 P0002 L8;

N23 G28 U0. W0.;

N26 M30;

O0002(TAP M12 SUB PROGRAM);

G184 W-40. R-2. D1. F6000. Q1.75;

G80;

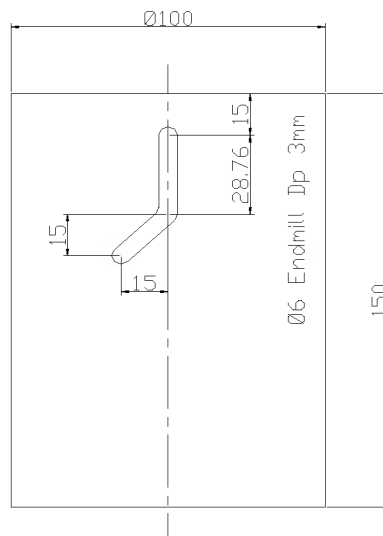
G00 H45.;

M99;

< Main program >

N1 Feedrate per minute command and zero return
N2 Tool No.1 and offset No.1 call
N3 Processing positioning
N4 C axis control ON
N5 C axis zero point return
N6 M-TOOL CW rotation
N7 Face drill cycle
N9 M-TOOL stop
N10 Zero point return
N12 Tool No.2 and offset No.2 call
N15 M-Tool CW rotation
N16 Face Drill Cycle
N18 M-Tool Stop
N19 Zero point return
N21 Tool No.3 and offset No.3 call
N25 Tap Sub-program call

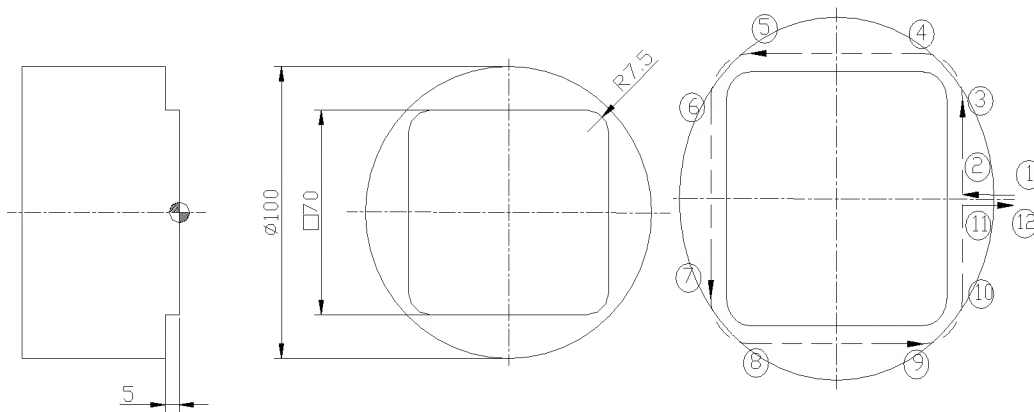
5.3 ENDMILL Machining



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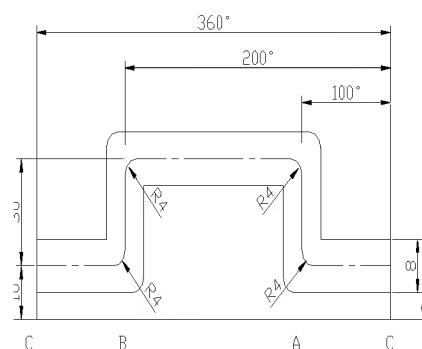
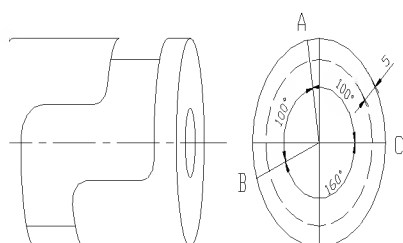
O0001;
N1  G98 G28 U0.W0.
N2  T0101;
N3  M35;
N4  G28 C0;
N5  M89;
N6  M33 S1500;
N7  G00 X104.Z-15.;
N8  G01 X94. F60.;
N9  G00 X104.;
N10 M35;
N11 G28 UO. W0.;
N12 T0303 ;
N13 M35;
N14 G28 C0.
N15 M33 S1200;
N16 G00 X104. Z-15.;
N17 M88;
N18 G01 X94. F40.;
N19 G01 Z-43.76 ;
N20 C8.6 Z-58l.76 ;
N21 G00 X104.;
N22 M35;
N23 M90;
N24 M05;
N25 G28 G99 U0,WO;
N26 M30;

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5.4 Polar coordinate interpolation

O 0001;	G01 X-55.;	⑤
G28 G98 U0. W0. ; (Feedrate per minute Command)	G03 X-70. C27.5 R7.5;	⑥
M35; C axis control ON	G01 C-27.5 ;	⑦
G28 C0. ; C axis zero point return	G03 X-55. C-35. R7.5;	⑧
T0101 ;Tool NO.1 and offset NO1. call	G01 X55. ;	⑨
M33 S1000 ;M-Tool CW rotation	G03 X70. C-27.5 R7.5 ;	⑩
X110. Z-5. ; ① Cutting positioning	G01 C0. ;	⑪
G12.1 ; Polar coordinate interpolation ON	G40 X110. ;	⑫
G42 G01 X70. F150. ; ②	Tool nose radius compensation cancel	
Tool nose radius compensation right	G13.1 ; Polar coordinate interpolation OFF	
C27.5 ; ③	M35 ; M-Tool rotation stop	
G03 X55.C35. R7.5 ; ④	M05 ; C axis control OFF	
	G28 U0. W0. ;	
	M30 ;	



5.5 Cylindrical interpolation

O 0001:
 G98 G28 U0. W0.;
 T0101;
 X115. Z-10.;
 M35;
 G28 H0.(or C0.);
 M33 S1000;
 G01 X100. F50.;
 G18 H0. W0.;
 G07.1 C50.(Radius value of the cylinder);
 C95.416;
 G03 Z-14. C100. R4.;
 G01 Z-36.;
 G02 Z-40.C104.583 R4.;
 G01 C195.416;
 G02 Z-36. C200. R4.;
 G01 Z-14.;
 G03 Z-10. C204.584 R4.;
 G01 C360.;
 G07.1 C0.;
 X115.;
 M35;
 M05;
 G28 U0. W0.;
 M30;

(Feedrate per minute Command)

Tool NO.1 and offset NO1. call

Cutting positioning

C axis control ON

C axis zero point return

M-Tool CW rotation

Z-X plane selection

(Cylindrical interpolation ON)

Cylindrical interpolation OFF

(M-Tool CW rotation Stop)

C axis control OFF